"Wood Pavement in the Metropolis."

BY GEORGE HENRY STATTON, ASSOC. M. INST. C. E.

(*Continued from page 255.*)

Fulham Road, Sydney Street to Arthur Street.—This section was paved in July, 1878, at a cost of 14*s.* per square yard, and in other respects was similar to the last-mentioned pavement. The surface is considerably worn, and the form of joint not only retains dirt but tends to round the blocks, the average depth of which is 4⅜ inches, or equal to an annual average wear of wood of 0.242 inch. The pavement will probably be relaid in 1885, when its life will have been seven years.

A large area of "plain" wood pavement has been laid in Kensington by Messrs. Nowell & Robson, who paved Kensington Road, Fulham Road, Uxbridge Road, and High Street, Notting Hill. The last-mentioned street was carried out in December, 1878, at a cost of 12*s.* 6*d.* per square yard, with a three years' free maintenance. The lime joint gave much trouble shortly after the work was completed, and, in places, it may be observed that it has allowed dirt to accumulate. The average wear is equal to 0.218 inch per annum.

In other Metropolitan districts, besides Chelsea, the local authorities have successfully laid a plain system of wood pavement by means of their own staff of workmen, particularly in St. Marylebone and Paddington. The credit of introducing this method is due to the Marylebone vestry, whose first work consisted in paving the portion of Oxford Street east of Regent Circus, in October, 1878. The blocks were laid upon an existing concrete foundation, and the work cost 8*s.* 4½*d.* per square yard, exclusive of the removal of the old stones. The blocks were repaired in 1882, 1883, and in 1884, at an approximate cost of 6*d.* per square yard. Plain yellow-deal blocks, 6 inches deep, were adopted, with a cement joint ½ inch wide; and they have worn to an average depth of 3.30 inches, but in some parts of the street the thickness is 1½ inch only. The surface shows considerable wear, and is uneven in places, the wood being so remarkably thin near the rests that it is a mere crust. The probable life of the wood is six and a half years. The average annual wear is 0.475 inch, and if reduced to the traffic standard it is equal to 0.306 inch. The heavy rate of wear is probably owing to the width of the joint, the author having taken up a piece of grout ¾ inch thick. This irregularity would have been avoided by the use of iron studs instead of temporary strips or laths. A large area was similarly laid in Edgware Road in October, 1880, and at the same cost. The surface is good; the annual wear is 0.198 inch, and if reduced to the traffic standard it amounts to 0.254 inch.

The Paddington vestry have laid 125,232 square yards in various streets. Praed Street was paved in July, 1879, with 6-inch plain yellow-deal blocks, at a cost of 10*s.* 7*d.* per yard, and the surface is in a fairly good state. At the eastern end, the blocks have been repaired on several occasions, the present depth of wood in the centre part being 4 inches to 4¼ inches.

Generally speaking the plain system appears to have given satisfaction, but the mode of jointing with lias-lime grout, or a wider joint than ½ inch, cannot be recommended. Upon inspecting the lime-joint after a few years' wear, it may be ascertained that it wears below the wood surface, that dirt accumulates in the joints, and that the blocks have either become rounded or the top edges "burred," to such an extent that surface has become bumpy. The lime-joint gave trouble when newly laid in Notting Hill in December, 1878, as after a sharp frost the grout, so to speak, "spewed" up, the rain filled the joint, and considerable sections of the pavement were literally afloat until the defects were remedied.

A system of blocking, which the author considers objectional is that by which the blocks of a new pavement are laid upon fresh unset cement floating, and, as the grouting is proceeded with the blocks rammed with a "pavior's" rammer, so as to obtain a smooth surface. Under this process there is a probability of the blocks being injured or split, apart from which it is found that when the time arrives for renewthe wood, the surface of the concrete contains the series of indentations instead of being smooth and even. The difficulty may of course be surmounted by chipping off the projecting parts and refloating the surface, but the repaving cannot be so expeditiously or economically carried out. The result of the author's experience and investigation induces him to submit (1) that the surface of the concrete foundation should be perfectly smooth and fully set before the blocking is proceeded with, and (2) that a carefully made cement-joint ¾ inch wide will not only be found simple and water-tight, but will prove as durable as the wood itself.

Cost.—With the exception of a small area, the whole of the wood pavement in Chelsea, about 50,000 square yards, has been laid by the Board's own staff. The estimated cost of the pavements in King's Road and Sloane Street was 11*s.* 3*d.* per square yard,[1] but, as previously stated, the actual cost amounted to 10*s.* 6*d.* per square yard, exclusive of £120 spent in the before-mentioned experiments. The pavement in Fulham Road cost 10*s.* 3*d.* per square yard, the difference being partially attributable to the fact that a portion of the old broken granite was used in the concrete foundation in lieu of ballast.

The details of the cost per square yard, are as follows, viz.:—

Item.	31,333 yards in Sloane Street and King's Road in 1879.	10,573 yards in Fulham Road in 1881.
	d.	*d.*
Labor in breaking up macadam surface and excavating	11.00	11.00
Cartage of old materials, including shoot for rubbish	9.04	9.80
Portland cement for concrete and grout	20.02	17.17
Thames ballast and sand for concrete, grout, and top dressing	8.56	5.80
Blocks	58.66	60.82
Studs	1.58	1.48
Labor in bottoming up and levelling, preparing and laying concrete, fixing studs in, wheeling and laying blocks, grouting, top dressing, watching and sundries	13.45	14.12
Labor and materials in permanently filling in margins	0.86	0.90
Sundries—plant, tools, superintendence, testing cement, oil, repairs, etc.	2.92	1.85
Total	126.09	122.94

NOTE.—No allowance is made for the value of the paving stones and broken granite taken up and re-used in other parts of the district, the minimum value of which amounted to £2,050, or about 1*s.* per square yard.

A reference to the Appendix, Table IV., will show that the variation in the prices paid for wood pavement in various parts of the Metropolis has been somewhat remarkable, maximum cost per square yard for laying a pavement and concrete foundation with entirely new materials, having amounted to 18*s.* 6*d.*, and the minimum to 10*s.* 6*d.* Owing presumably to competition and to the experience which has been gained, together with increased facilities, the cost has gradually been reduced to reasonable limits, as compared with the charges made eight or nine years since.

Management.—However excellently a street carriageway pavement may have been constructed, its condition will soon become unsatisfactory unless its maintenance receives proper supervision. Good management implies not only that repairs shall be promptly and efficiently executed, but that the services of cleansing, watering, and sanding must be properly carried out; in short, the essentials of proper management are to be found in the judicious application of the scraper and broom, of water, and of grit, and in the immediate removal of defective blocks. The reinstatement of gas, water, and drainage-trenches must be classed under the first heading; and, although an apparently small matter, yet from the frequency of such openings, so serious an interference with the street surface is created, that in the course of a few years surface uniformity cannot be maintained unless this work is very carefully executed, and ample time allowed to elapse before the traffic is allowed to pass over the work. After a pavement has been laid for three years the existence of the defective blocks becomes apparent, as by this time, the first effect of compression having ceased, the fibres of such blocks begin to yield under traffic pressure, with the result that slight surface depressions are formed. When this happens a bumping motion is created, and as the wheels then strike upon the edges of the adjoining blocks it is obvious that the surface must become irregular; and depressions or hollows a foot square or more are soon formed, which, unless promptly remedied, materially spoil the surface.

To avoid slipperiness and to ensure many of the advantages claimed for wood pavement, it is essential that a thorough and systematic service of cleansing must be carried out, especially where macadam pavements are contiguous to wood, as in damp weather a considerable amount of mud is imported from them. In connection with the wood pavement in Chelsea there is a regular street orderly service, by which horse-droppings are removed and deposited in bins. In addition thereto the wood pavements are washed once or twice a week, and are cleansed daily either by horse-sweeping machines or by hand-labor. In the absence of heavy rains mere sweeping fails to keep wood pavement clean, and washing them becomes essential. To effect this water vans are sent out before midnight, and the surface is so thoroughly soaked that, by the time the sweeping machines commence to work at 3 A. M., the dirt is easily removed, the entire operation being concluded in the forenoon. The ascertained cost of this service, including labor and horse hire in washing and sweeping, street orderly work, and collection and removal of the sweepings, amounts to 4½*d.* per square yard per annum, as against 11*d.* per square yard for macadam previous to the substitution of wood. It has been asserted upon good authority that the cost of cleansing wood pavement is very trivial; this is slightly misleading, the proportions being approximately—

Macadam	1.00
Wood	0.41

Theoretically the amount of mud created upon the surface of wood, as also in the case of asphalt, should be almost nil; but practically the author finds that some 2,700 cartloads are annually removed from a length of about 3 miles in Chelsea. Therefore after making every allowance for the conversion into mud of 350 loads of sand placed on the wood when slippery, it is obvious that a great portion of the mud is imported from the adjacent macadam.

The plentiful application of water prior to the work of cleansing is most beneficial, both in preventing dust, and, from a sanitary point of view, in removing the cause of obnoxious smell; but as the Metropolitan water-supply is not yet in the hands of the ratepayers, its use for this purpose is materially restricted. The author ventures to assert that the system of cleansing thus described is amply sufficient to obviate slippery surfaces caused by the accumulation of greasy mud, and that the summer watering may be so carried out that a minimum wetting will suffice to keep down the dust. Letters have recently appeared in the

[1] Minutes of Proceedings Inst. C. E., vol. lviii., p. 75.

Times with reference to the watering and cleansing of wood pavements, in which it has been strongly urged that such pavements should not be watered at all. When it is considered in what an unskilful manner street-watering is sometimes done, and that, owing to the stupidity or carelessness of carmen, considerable danger to locomotion is caused by overwatering a dirty pavement, there may be some justification for the contention. Doubtless horses travel better on dry wood pavement than on a watered surface, but in the absence of rain, watering is an absolute necessity for keeping down fine dust, more especially upon a hot windy day, when at least five or six wettings are required. Watering is necessary for the preservation of the wood itself, as without water it would be materially injured by abrasion under such conditions. It is also questionable whether the very fine dust which must be given off under a non-watering system, would not become so serious as to be injurious to health and promote disease of the eye; but apart from this, the nuisance from the heat and dust combined would become intolerable.

In continuous damp and foggy weather and on frosty nights wood pavement is especially liable to become slippery; therefore, to ensure a safe foothold for horses, its surface should be covered with a thin layer of Thames sand or grit. In Chelsea it has been found that this operation can be more expeditiously and evenly carried out by horse-machines known as "sand-distributors" than by manual labor alone. Night gangs have been organized, and, according to the conditions of the weather, the machines are sent out either at night or early in the morning; in the latter case the whole of the wood is sanded and made fit for traffic by eight o'clock. The operation is beneficial to the wood itself, and might be advantageously carried out at other times, because the grit becomes so well worked into the ends or fibres of the blocks that it not only affords protection to them but ensures a better foothold for horses. The ascertained cost of the sanding does not exceed ½*d.* per square yard per annum.

Durability.—One of the most important factors in connection with durability is the amount of traffic to which the pavement is subjected. As the author has been unable to obtain complete information thereon he has had to rest content with the available figures, and has reluctantly omitted results and comparison of other important streets. Table I. in the Appendix shows (1) the daily traffic weight per yard width; (2) the depth of annual wear of wood; and (3) the annual wear of wood as reduced to a standard of traffic equal to 750 tons per yard width daily, or 235,000 tons per annum, exclusive of Sundays. It is gratifying to remark that there is a growing tendency to make observations and keep records of traffic weight, wear, and cost, and it is only by these means that reliable data can be obtained. It is to be hoped, therefore, that both local authorities and wood-pavement companies will institute the desired inquiries, by which means much valuable experience and knowledge will be gained. The comparative annual wear reveals inconsistencies. For instance, the wear of the asphaltic pavement in Fleet Street with the maximum traffic weight, or 24th on the list, is but 16th in point of wear, whereas the same system with 13th and 9th traffic-weight positions, takes the high places of 24th and 23rd in wear. Lloyd's pavement in Regent Street has an 8th traffic-weight position, but a 20th in wear. The wear of the Improved, of Henson's and of the plain pitch-pine pavements compares favorably in all cases with the traffic weight. The lesson to be drawn from these figures would appear to be that the asphaltic and Lloyd's systems are not successful; and the author cannot help regretting that Regent Street should have been paved upon these particular systems. The pavement in Parliament Street is stated to have worn ½ inch only in three and a quarter years, but it must not be forgotten that its real wear has scarcely begun, and that the traffic weight is high. Should its life be eight years (which is extremely doubtful,) it would take a higher position, as the annual cost would probably be 1*s.* 8*d.* per square yard (Appendix, Table III.)

It is interesting to notice that some pavements have exhibited a considerable degree of durability and have had a tolerably fair life. (Appendix, Table IV.) In this Table the pavements and periods under the heading "actual" life relate to accomplished facts, while several under the heading "estimated" have already nearly realized the life allotted to them. In other cases the estimate is given after inspection and measurement or inquiry. The number of the pavements is necessarily restricted in consequence of the absence of traffic-weight records.

(TO BE CONTINUED.)

The Sooysmith Concrete Machinery.

To make a perfect concrete the following conditions must be fulfilled:

1st. The materials must be of the proper kind.

2d. They must be thoroughly mixed in the proper proportions, and this quickly, and,

3d. The mixture must be properly put in its destined place.

It is only of the second necessity that we need speak in considering machinery for making concrete.

To measure out in measures of proper sizes, the right proportions of sand, cement, and stone is, where a large quantity of concrete has to be made quickly, very tedious and requires at least one additional handling, which of course adds materially to the cost per yard, but aside from this and all other objections, on account of slowness and expense, is the very important one that, though in this way we may be sure to get one bushel, for instance, of cement to two bushels of sand, we are still dependent upon the accuracy of the shovelers to get it fed to the mixer, provided one is used, in just the right proportions.

It is then desirable to have it fed to the mixer in such a way that with each cubic inch, we will say, of cement, there is the desired numbers of cubic inches of sand introduced.

To accomplish this, and to insure a uniform feed to the mixer, a patented proportion meter as shown at B, on the sketch, is used.

This is simply a horizontal cylinder above the spiral mixer and turned by gearing from this latter.

The cylinder has two sets of compartments *c* and *d*, the relative sizes of which can be fixed as desired by adjusting the movable partitions between them, or by putting in filling blocks at the bottom of one, or the other set of compartments.

The cylinder is sheathed by a covering of sheet iron and surmounted by a hopper, which is divided into two parts by a partition which can be placed immediately over the partitions in the cylinder below. The cement is then shovelled into one side of the hopper and the sand into the other side.

The gearing of the cylinder is such that its speed is just right to feed the amount of material to the spiral which the latter is capable of mixing.

One of the advantages of this arrangement is that the feed is always in proportion to the speed, and it is thus easy to turn out more or less mortar by altering the speed of the engine running the mixer.

The sketch shows the concrete mill, as it is called, mounted on a barge.

As the meter revolves, the sand and cement drop from the hopper into its compartment, and are carried around and dumped into the spiral conveyor below.

As each compartment comes to the bottom of its revolution its contents pour out and thus the feed is constant and uniform.

The materials are then conveyed in the trough *f*, being thoroughly mixed together dry in the course of the irtransit to, the middle of the spiral where the desired quantity of water is allowed to flow in; from here to the end of the conveyor the mass becomes mortar, being thoroughly turned, and rubbed together.

The mortar drops into the upper end of a mixer made by the Pioneer Iron Works, Brooklyn, into which the requisite quantity of stone or gravel is introduced.

It was found that after a little practice the stone could be shoveled in with tolerably uniform results.

It is believed, however, that it would be better to use a cylinder without covering, or hopper similar to the sand and cement meter to measure the stone or gravel as well, or to use an elevator run at the proper speed dumping directly into the mixer.

The mixer into which the stone is shoveled is seven feet in length and is set at an inclination of about ten inches in its length. From it the concrete falls into wheel-barrows, or large buckets.

The latter are only used when the concrete is to be deposited at a height inconvenient to wheel to, in which case the derrick represented is used. The entire mill is run by an engine 7" × 12".

Its capacity is only limited by the ability to take the mixed concrete away.

A continuous line of wheel-barrows was found to be the best way to convey the concrete to the points where it was deposited. While one barrow is moving away, and another taking its place, a man keeps the concrete from pouring upon the floor by simply holding a shovel over the mouth of the mixer. One hundred and eighty cubic yards have been frequently mixed in a day of ten hours. The capacity of the mill is probably about double that amount.

The steel conveyor, supplied by Caldwell, of Chicago, was nine inches in diameter, and about twenty feet long.

What might at first seem a defect in this mill, namely, its large size, is in reality a necessity; for the point at which different materials are fed, and the discharge point, must be well separated to give the space for materials and movement required. Two of these mills have been in use by Wm. Sooy Smith & Son, at the Havre de Grace Bridge; in one of them the materials are hoisted to the points of feed by derricks and in the other wheeled directly from barges. In each case there is no handling of them after they are fed to the machine, except to wheel the mixed concrete to place and tamp it.

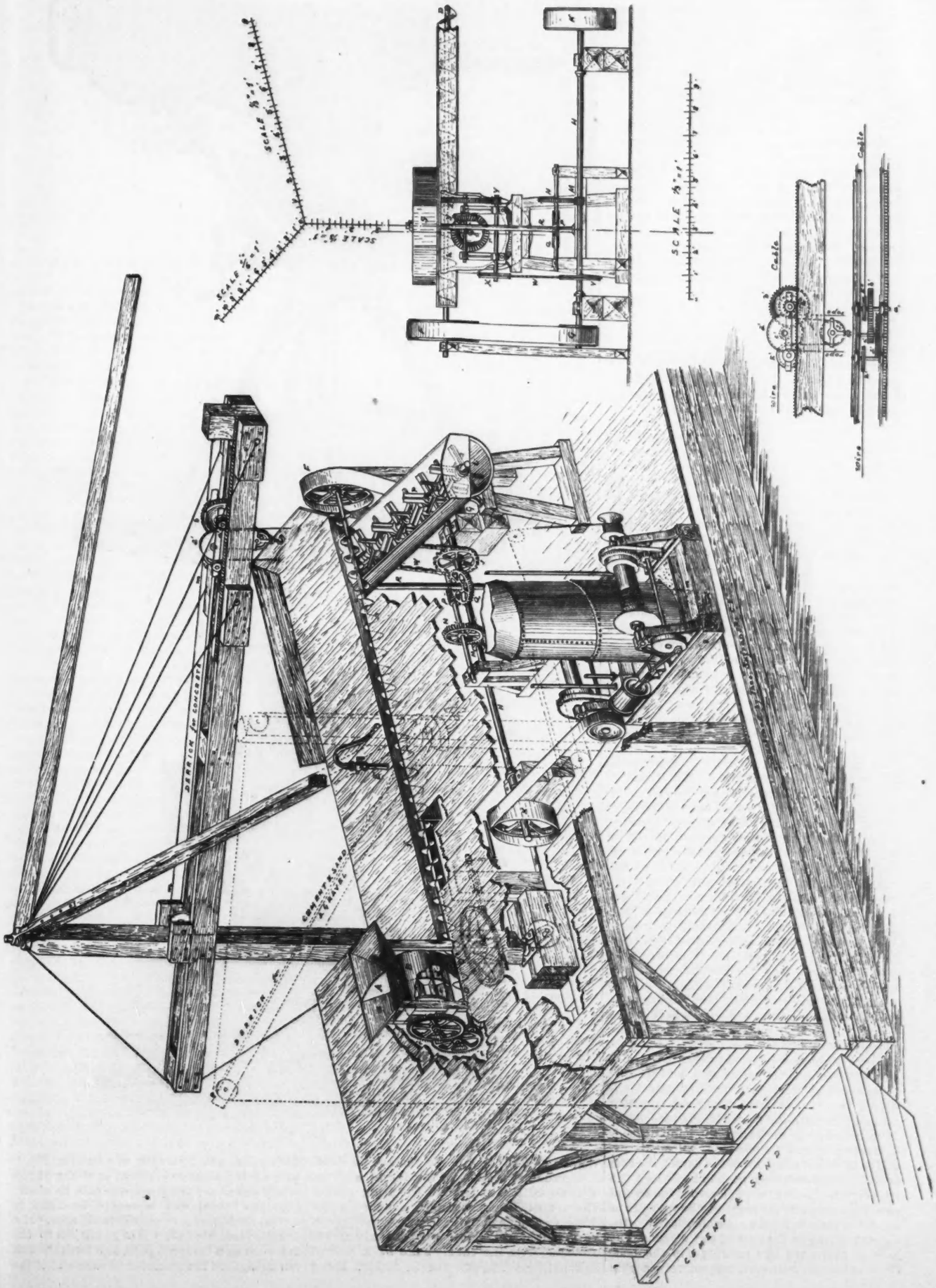
This machine, aside from its advantages in point of economy, was a necessity at the work in question, where the progress often depended upon the rate at which the concrete could be made, and it is believed that in no other way could the result have been so well accomplished.

The proportion meter is the invention of Charles Sooysmith and the firm of which he is a member.

Wm. Sooy Smith & Son, is arranging to supply full outfits of the machinery herein discribed.

LITTLE ROCK, ARK., November 28.—Articles of association of the Little Rock, Pine Bluff & White River Railway Company were filed with the Secretary of State to-day. The road begins at Argenta and will run to Rob Roy. It is now built from Rob Roy to Swan's Lake and will be extended on to Pine Bluff, thence to Argenta. C. M. Neel is President, and C. M. Neel, Jr., Secretary. The capital stock is taken by C. M. Neel, M. A. Bell, A. M. Neel, C. M. Neel, Jr., and I. F. Burke. The parties interested are all citizens of the State.

THE SOOYSMITH CONCRETE-MIXING MACHINERY IN USE AT THE B. & O. R. R. BRIDGE, HAVRE DE GRACE, MD. (*For description see page* 266.)



The Maxim Machine Gun.

The mitrailleuse or machine gun, as hitherto constructed, is a weapon in which all the functions of loading, cocking, firing and extracting the empty shell from the gun are performed by turning a crank or by working a lever. The first successful gun of this kind was the invention of Dr. Gatling, an American. This gun was brought out during the war of the American rebellion, and before metallic cartridges, which are so essential to the success of a machine gun, had reached their present degree of perfection.

Dr. Gatling did not succeed in getting his gun used to any extent in the great American war. The first machine gun which ever saw service in the field was the French mitrailleuse. This gun was large, absurd, and clumsy, and so heavy that it required to be drawn by horses; it would fire but 150 shots per minute. It did not comprise the necessary elements of success, and consequently failed.

The next machine guns to make their appearance were the Hotchkiss, the Lowell, the Nordenfelt, and the Gardner. All of these, except the Nordenfelt, were operated by a hand crank, the Nordenfelt alone being actuated by a reciprocating lever. All of these guns must necessarily be mounted upon a firm base, and be trained and elevated by screws and worm gears. If they were made to work freely upon a pivot or universal joint, they would not be firm enough to remain stationary while the crank or handle was being operated. The safe speed at which a machine gun can be fired depends in a great measure upon the kind and age of cartridges used. For instance, if cartridges have been made some time a trifling amount of moisture may have accumulated in the powder near the primer. When this dampness occurs, the cartridges are said to hang fire; that is, they do not explode at the instant of being struck. Suppose that one cartridge in a thousand should hang fire, it would be necessary to operate the gun sufficiently slow on the entire series, to give this slow cartridge time to explode, otherwise it might be drawn from the barrel before it exploded, or in the act of exploding, in either of which cases it would disable the gun. To this may be attributed a great deal of the trouble in operating machine guns, and their liability to get out of order when most needed.

In the gun of which we publish illustrations and which is the invention of Mr. Hiram S. Maxim, of 57A, Hatton Garden, London, slow cartridges do not offer an obstacle to the rapid firing of those which will explode quickly, from the fact that no cartridge can be drawn from the gun until it has exploded, as it requires the force of its own explosion to unlock the block from the barrel and extract the empty shell. In Mr. Maxim's new gun there is but one barrel, and all the functions of loading, cocking, firing, withdrawing the empty shell from the barrel, and ejecting it, are performed by the recoil resulting from the explosion. This gun may be likened to a small engine, the barrel under the influence of the recoil acting as the piston, the block as the crosshead, and the sear and trigger as the valve gear. The cartridges to the number of 333 are placed side by side in a canvas belt, secured together with brass eyelets and strips. One end of this belt is connected to the arm, and the gun is operated by hand until the first cartridge is driven into the barrel. Then the trigger is pulled, this cartridge explodes, the breech bolt is unlocked from the barrel, the empty case is extracted, moved to one side, a loaded cartridge is brought in front of the barrel, the arm is cocked, the cartridge pushed home and the trigger pulled, when the explosion of the second cartridge operates the same as the first. Thus the firing may be kept up automatically without any action on the part of the attendant as long as there are any cartridges in the belt. Our engravings represent respectively a side view and a front view of the gun and its stand, a longitudinal section of the barrel and the mechanism, and a detail of the firing device. The weapon is mounted upon a tripod stand (Figs. 1 and 2,) and between it and the top of the stand there is placed a magazine, which is protected from the enemy's fire by a pair of light shields. The gun can be rotated about the vertical axis by means of a handle (Fig. 1) which turns a tangent screw, or if the three-armed nut at the bottom of the axis be slackened, the barrel can be moved by hand to spread the fire over a considerable area. If a definite piece of ground is to be subject to the fire, such as a bridge, a pass, or a ford, the gun can be sighted in succession to each end of the

THE MAXIM MACHINE GUN.

Fig. 1.

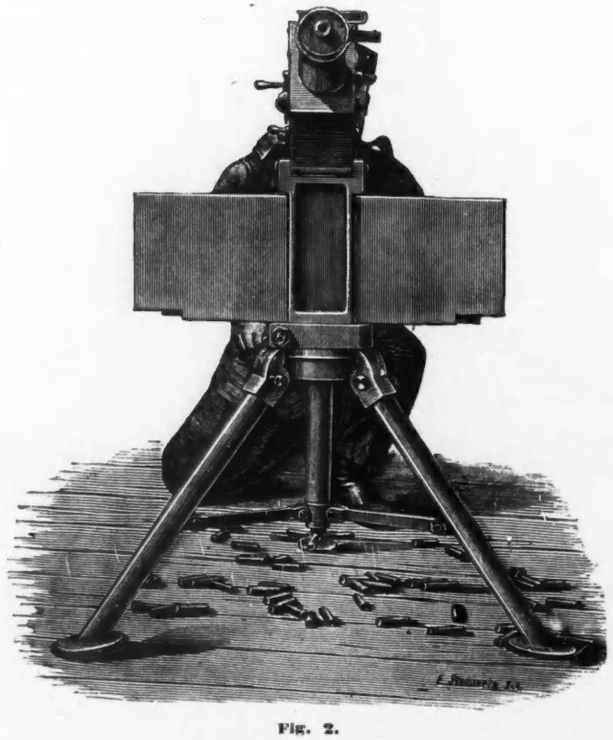


Fig. 2.

THE MAXIM MACHINE GUN.

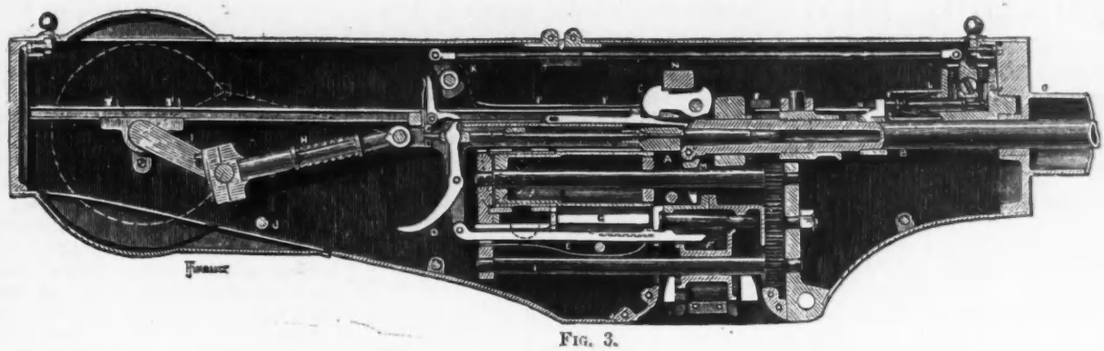


FIG. 3.

Fig. 3.

space and its motion beyond those limits prevented by adjustable nuts on the screw spindle. The elevation af the barrel is altered by turning the handwheel on the inclined strut, stretching from the stand to the rear of the gun. By slackening a clip on this strut the screw is thrown free, and the weapon can be elevated and depressed by hand.

We will now consider the mechanism by which the loading and firing is effected. The barrel B, which is inclosed in a water jacket (Fig. 3,) is capable of a longitudinal motion of about seven-sixteenths of an inch upon the explosion of a cartridge, and moves back, pushing before it the breech bolt, the sear, and the rest of the moving parts. Its motion is in the first instance opposed by two springs *e e* (Fig. 4) which are forced outwards by the toggle arms *d d*. As soon as the arms have passed the center, the springs begin to close again, and aid the motion of the barrel. At first, as we have already said, the barrel and the block or breech-piece A, travel back at the same speed, but for the spent shell to be extracted and the new cartridge to take its place, the block A must leave the barrel a considerable distance for the other mechanism to come into play. The two are at first fixed together by the locking catch C, which is held down by the stop N. A slight motion carries the catch free of the stop, and a little more lifts the catch, by its tail coming in contact with the stop. The bolt and the barrel are then free of each other, and the former receives a rapidly accelerated motion from the lever *a* (Fig. 4.) This lever is pivotted on the barrel, and moves with it. As the barrel approaches the end of its stroke the point of the lever meets the stop *b*, and it commences to rotate about its pivot. In doing this it forces forward the piece *c* connected to the block, first with a slow motion and then with a gradually augmenting one, as the leverage of one arm increases and that of the other diminishes, while the lever rolls over the stop and the piece *c*.

By the action of the lever the barrel is arrested, while the block and the mechanism attached to it continue to move until the crank I gets on to the back center. As soon, however, as the block has commenced to leave the barrel, and before the latter has come to rest, the extractor M strikes the peg which stands to its path, and turning on its pivot on the barrel, draws the shell about ¼ in. out of the gun. This extractor has two arms, shown in dotted lines, which take hold of the empty cartridge at each side, and withdraw it with certainty. The extraction is completed by a hook shown (Fig. 3) attached to the crosshead. This hook runs under a fixed spring which is curved upwards at each end to reduce the pressure when the shell is being started, and when it is about to be released. The empty cartridge case is deposited in one of the pockets of the cylinder G, which is partially rotated just as the crank reaches the back center, and is carried round to be dropped out after the next shot. This cylinder is visible in Fig. 2, where a shell is seen in the act of falling out. The partial rotation of the cylinder brings the next pocket, which has already been charged, into a line with the barrel, and now the first series of operation is complete. The recoil has taken place, the breech block unlocked, the shell first started, and then completely extracted and removed, and the new cartridge brought into position for loading.

The next series, which is about to commence, consists in cocking the hammer or striker, pushing the cartridge home, locking the breech piece, and releasing the sear. As the crank approaches the back centre the tail D of the cocking lever meets the stud J, and the catch is caught and detained by the sear. The main spring, which is somewhat indistinctly shown coiled round the striker, is thus compressed and held ready for action. When the crank has passed the centre, the breech-block moves towards the barrel, pushing the

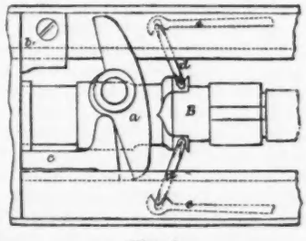


Fig. 4.

cartridge before it, until the latter is home and the block is locked by the catch C. The momentum of the crank and crosshead is sufficient to carry the barrel foward until the toggle arms *d d* pass the centre, and the springs *e e* are in a position to urge it to the end of its travels. If the gun is set for very rapid firing they do this immediately, and the sear coming into contact with the cam K, the striker is released, and the cartridge fired. After the shots have been fired the same cycle of operations is repeated, with this difference, that the crank, instead of starting from the position shown in Fig. 4, occupies the dotted position and commences to rotate in the opposite direction. It never makes a complete revolution. But if the gun be not set for a rapid rate of firing, there is a pause after the breech is locked, and the length of the time is determined by the adjustment of a hydraulic buffer, resembling in principle a cataract cylinder. This appliance (L, Fig. 3) consists of a piston working in a cylinder with a by-pass between its two ends. This by-pass is a plug, and is provided with a handle working over a quadrant on the outside of the case. This quadrant is marked for speeds between *nil* and the maximum, according to the opening which is afforded between the two ends of the cylinder at the various angles. The rate of fire can be reduced in practice to one shot in every twenty-five seconds, and by very careful adjustment to one in fifty seconds. The operation of the hydraulic buffer is as follows: Upon the upper side of the barrel in a stop which, just before the end of the forward stroke, meets the piston of the buffer, as clearly shown in Fig. 3. Under the influence of the springs *e e* it forces the liquid through the plug until the barrel has moved far enough to lift the sear, and then the explosion takes place. There is a valve in the piston of the buffer to allow it to be returned quickly by a spring during the recoiling of the barrel.

This completes the description of the introduction, firing, and extraction of a cartridge, but it remains to explain how the charges are withdrawn from the belts mentioned above, and introduced into the pockets of the cylinder G. The full belt is drawn out of the magazine (Fig. 1), and passes over the wheel F which has recesses in each flange for the ends of the cartridges to rest in. This wheel is geared to the cylinder G. In the firing position a hook or extractor E stands below the cartridge, and when the crosshead goes back this catches a cartridge and draws it into a pocket on the underside of the cylinder, where it leaves it to be carried upwards to the barrel by the rotation of the cylinder. The empty belt is fed out of the opposite side of the machine (Fig. 1), and the lengths can be taken apart by unhooking and refilled ready to fed in again.

The external of the hydraulic buffer also acts as a trigger, for if the by-pass be opened when the gun is loaded the explosion follows instantly, while if it be entirely closed the gun cannot be fired. As a means of precaution the sear is mechanically locked when the by-pass is stopped. The crankshaft is carried through the casing and is furnished with a handwheel which is worked in starting the gun until the first fire has taken place. It is also used when ever a faulty cartridge, which will not explode, stops the action. In such case a single revolution throws out the obstacle, and the automatic action is at once resumed.

The gun stands about 3 ft. high and is 4 ft. 9 in. from the muzzle to the rear of the firing mechanism. It can deliver any number of shots per minute from two or three to 600, the latter being, of course, a kind of trial-trip performance, under favorable conditions. At all rates it is perfectly steady, and the gunner is perfectly free to concentrate all his attention upon the aim without having his vision or his steadiness interfered with by turning a handle.

No one can fail to be struck with the wonderful ingenuity and great promise of this new weapon. Its automatic action, its power of regulation, and its rapidity of fire must recommend it to the military authorities, while its steadiness and the small demands it makes upon the attention of the man in charge, must greatly enhance its value in action, where it is not the number of shots, but the number of hits, that count.—*Engineering.*

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PRESIDENT ARTHUR, in his annual message, recommends the recently concluded treaty authorizing a canal and railway by the San Juan and Nicaraugua route as of commercial and political advantage not to be overestimated. In regard to the coast defences he says:—The time has come when such defences can be prepared with confidence that they will not prove abortive,and when the possible result of delay in making such preparation is seriously considered, delay seems inexcusable." He concurs with the Secretary of War in urging that the $6,000,000 required to begin the work, be at once granted. He believes also that considerations of wise economy, a just regard for our future tranquility, and a true appreciation of the dignity and honor of the Republic demand the restoration of our navy to the high state of efficiency which formerly characterized it.

AT the annual meeting of the Directors of the Hudson Tunnel Construction Company at their office No. 2 Nassau Street, New York, the old officers were re-elected, including Cyrus G. Francklyn, President, and F. B. Jennings, Secretary. W. H. Perkins is President of the Tunnel Railroad Company, and O. A. Gager is Secretary. No work is being done by the construction company on account of lack of funds. The works on both sides of the river are flooded, but in such condition that work could be pushed after a few days pumping. Work was discontinued on the New Jersey side of the river, November 5, 1882, with 1,550 ft. of the north tunnel complete, and about 565 ft. of the south tunnel completed. On the New York side work was suspended July 20, 1883, with 150 ft. of north tunnel and 23 ft. of the south tunnel completed. Headings at both ends in north and south are bulkheaded.

THE work on the reinforcing of the west main abutment of Chestnut Street Bridge, in Philadelphia, is progressing successfully. Messrs. Andersen and Barr, the contractors, have finished the sinking to rock and filling with concrete of the 8 ft. cylinder at the southwestern corner, and are now engaged in putting in the connection required between the top of the cylinder and the foundation masonry. The cylinder at the northwest corner is well underway. Some delay has been occasioned by finding a 12 ft. layer of very heavy boulders lying just above the bed rock, instead of river mud and gravel as indicated by the borings.

The plant used by the contractors is all new, and is admirably adapted to this and work of a similar nature. The air-compressor is built by the Delamater Iron Works, of New York, and is a double straight-line compressor with Westinghouse engines, automatic cut-off regulated by the air pressure, and a system of water-jacketing for the air cylinder so arranged that the water passes around the cylinders, and does not touch and consequently cut the piston or interior of the cylinder. A fly-wheel and gearing between the engines permits their use for hoisting, or other purposes, by simply disconnecting the air-compressing portion. An Edison Electric light outfit is used for all lighting purposes within the cylinder being sunk, in the air-lock, and outside.

The New Croton Aqueduct.

With this issue we give a map and profile and general plans for tunnel and special shafts of the new Croton Aqueduct, the first of a series of plans of this important engineering work which we propose to publish.

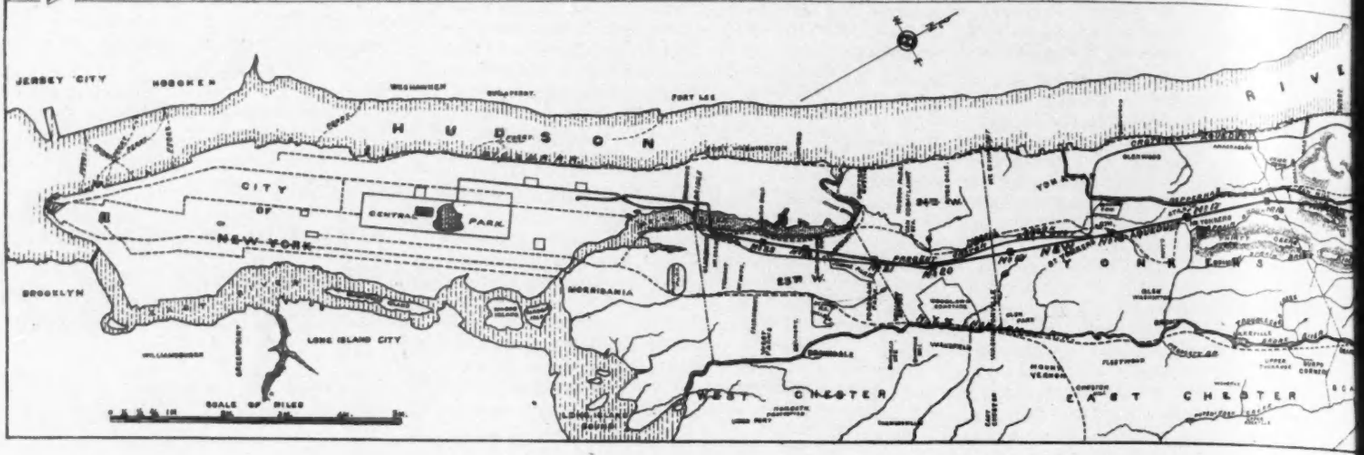
As a preface to our general description we commence with as complete a historical sketch of the inception of the new aqueduct as the meagre and scattered sources of available information will permit. In 1875 two projects, known as the Sawmill and Bronx River plans, were submitted for supplementing the water supply of the city of New York, but owing to their enormous cost, insufficient supply proposed, 150 million gallons daily, and other reasons too numerous to record here, both schemes were rejected and no further definite action was taken until 1881, when the present aqueduct plan may be said to have had its birth. In the year last named a bill was framed and submitted to the Legislature asking for authority to build the works required. This bill was strongly endorsed by the city authorities, and in May, 1881, it passed both branches of the Legislature. Although the engineers of the Croton department personally appeared before Governor Cornell and vigorously urged the signing of the bill as a measure of great public necessity, this signing was delayed until the limit of time expired, and the bill failed to become a law.

The Department of Public Works took advantage of this forced delay by making further and more complete surveys for the contemplated work, and its plans were recommended for general economy, efficiency and permanence by J. B. Jervis, E. S. Chesbrough and J. B. Francis, three of the most experienced hydraulic engineers in the country; Mr. Chesbrough had been directly connected with the project as consulting engineer for several years.

In 1883, under a new State administration, another Croton Aqueduct bill was framed with great care, imposing all possible checks and restrictions upon any features likely to interfere with its passage as a public measure of great urgency.

A resolution of the Senate, of January 9, 1883, requested Mayor Edson of New York to appoint a committee of five citizens to examine with him into this question of water supply and the proposed plan for extending it, and to "report for the information and guidance of the Legislature as to its practicability, cost, etc." This committee, accordingly appointed, was composed of the following gentlemen:—Mayor Thos. A Edson, Hon. O. B. Potter, John T. Agnew, William Dowd, Amos F. Eno and Hugh N. Camp. They first requested from the Chief Engineer of the Croton Aqueduct a report "in writing, on the amount and location of storage required in the Croton Basin, for a daily supply of 150,200,250 and 300 million gallons, and to append the opinion of the Consulting Engineer." In obedience to this request Chief Engineer Isaac Newton submitted a statement of the data required on February 21, 1883, and recommended the erection of a dam at Quaker Bridge near the mouth of the Croton River, with a view to impounding all the available water from the Croton Basin. The Consulting Engineers, referred to in the Committee's resolution, were J. B. Jervis, E. S. Chesbrough, Jas. B. Francis, Geo. S. Greene, Julius W. Adams and Robt. K. Martin; all of these experts unhesitatingly endorsed the Quaker Bridge plan "as the best, in fact the only plan that can, consistently with the best interests of the city, be adopted for securing a large additional water supply from the Croton Basin."

PROFILE OF NEW CROTON AQUEDUCT



GENERAL PLAN OF SHAFT FOR AQUEDUCT UNDER PRESSURE

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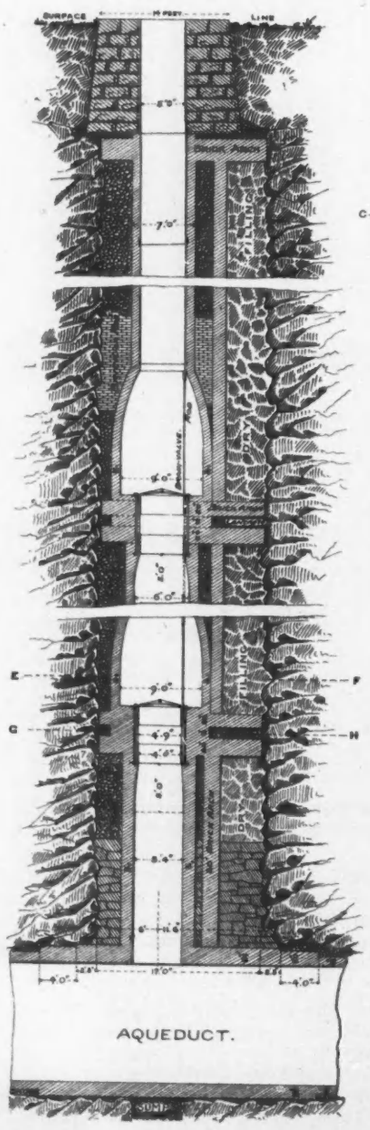
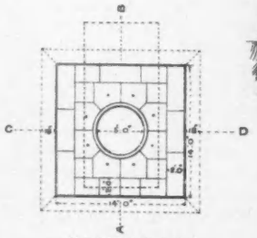




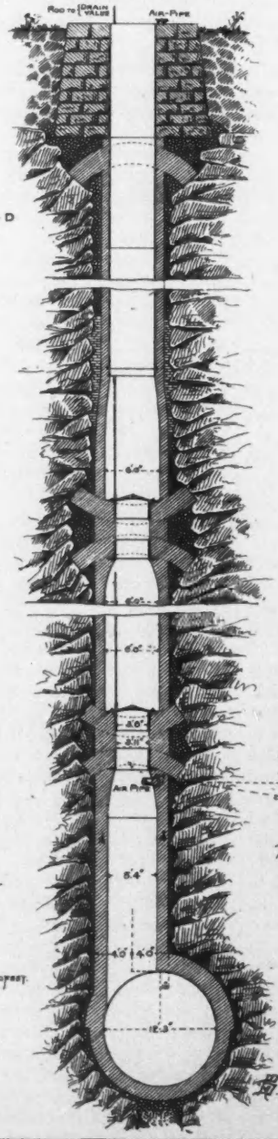
SURFACE PLAN.

HOR. SECTION E F.

HOR. SECTION G H.

General Scale

VERT. SECTION C D.



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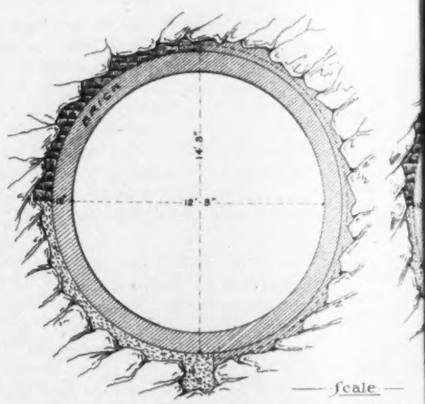
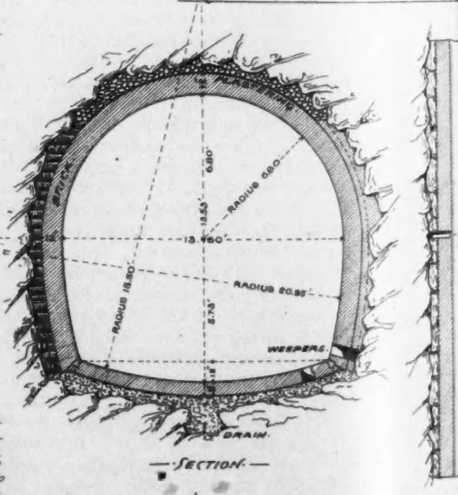


AQUEDUCT IN ROCK TUNNEL



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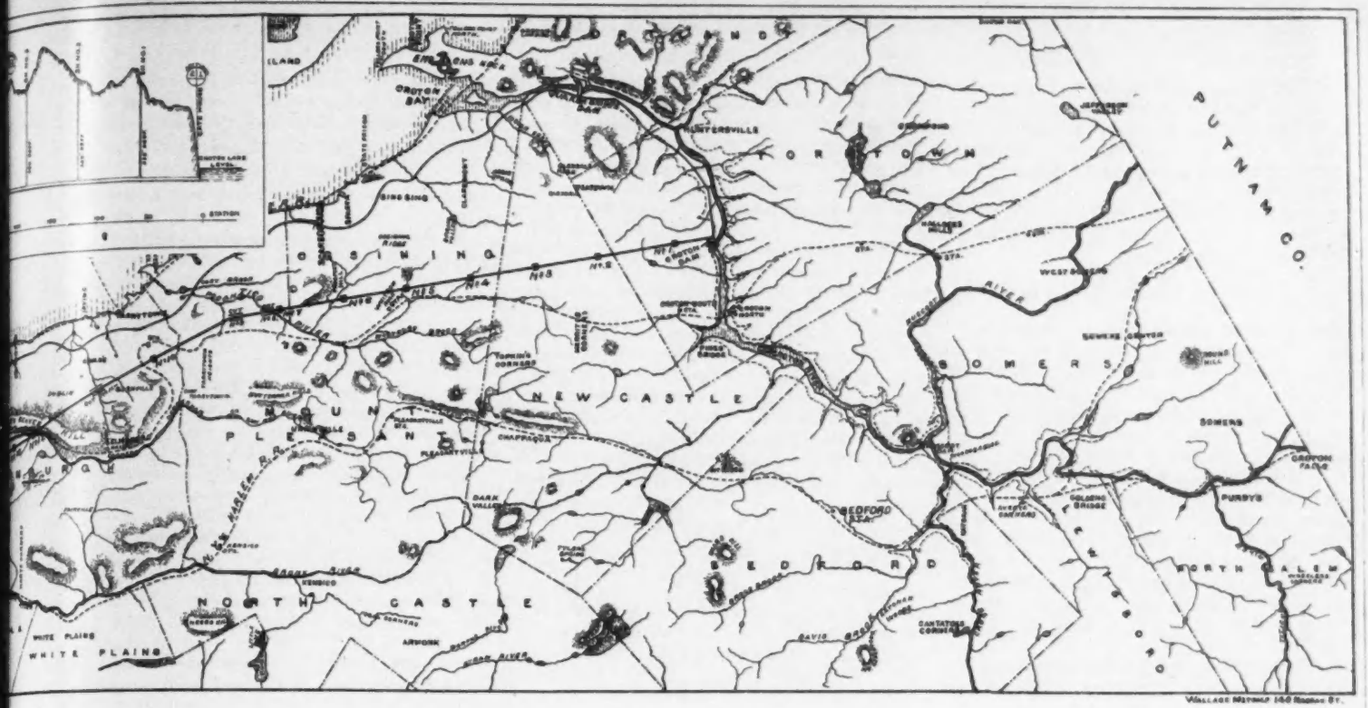
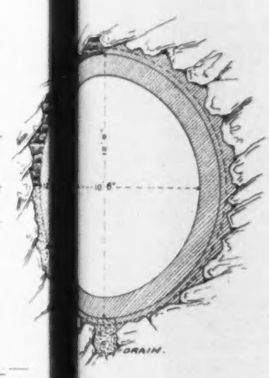
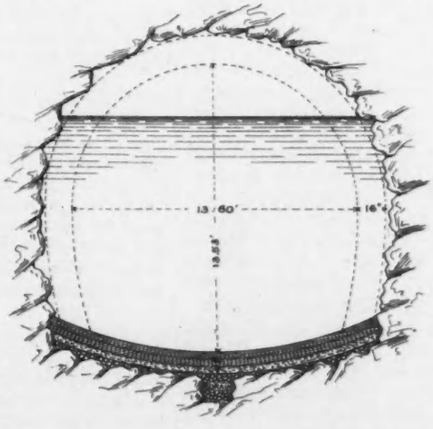
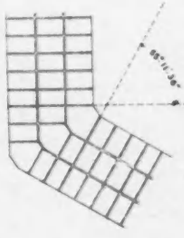




AQUEDUCT WITHOUT MASONRY
(EXCEPT FLOOR)

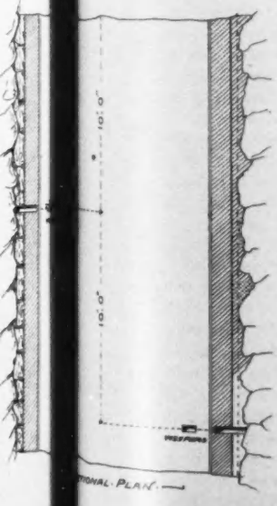


SPECIAL BRICK.



DETAIL OF CORNER OF AQUEDUCT.

WEEPERS.



MAP AND PROFILE

OF THE

NEW CROTON AQUEDUCT.

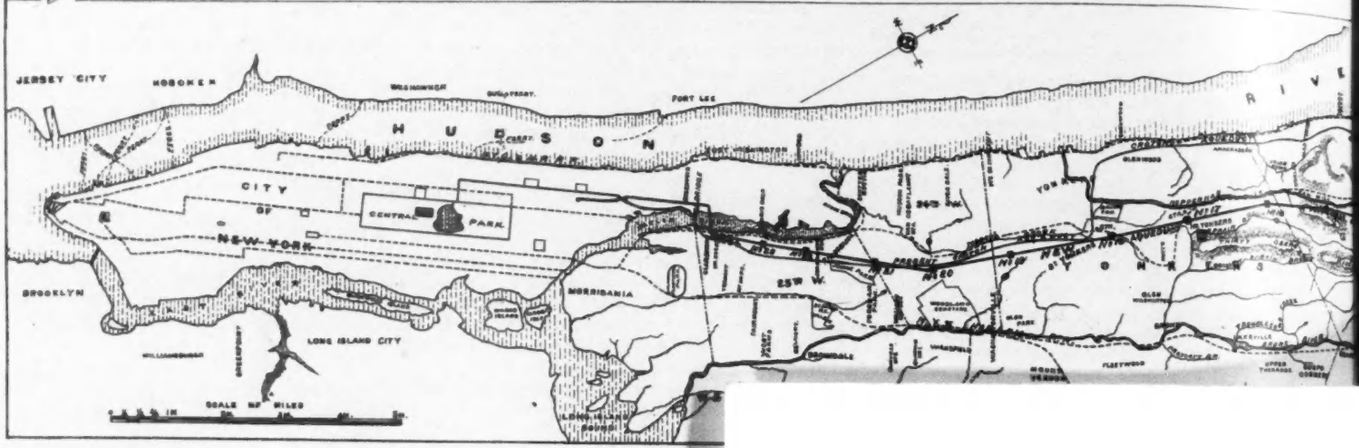
ALSO

GENERAL PLANS OF

TUNNEL, SHAFTS, &c.

1884.

PROFILE OF NEW CROTON AQUEDUCT



GENERAL PLAN OF SHAFT FOR AQUEDUCT UNDER PR

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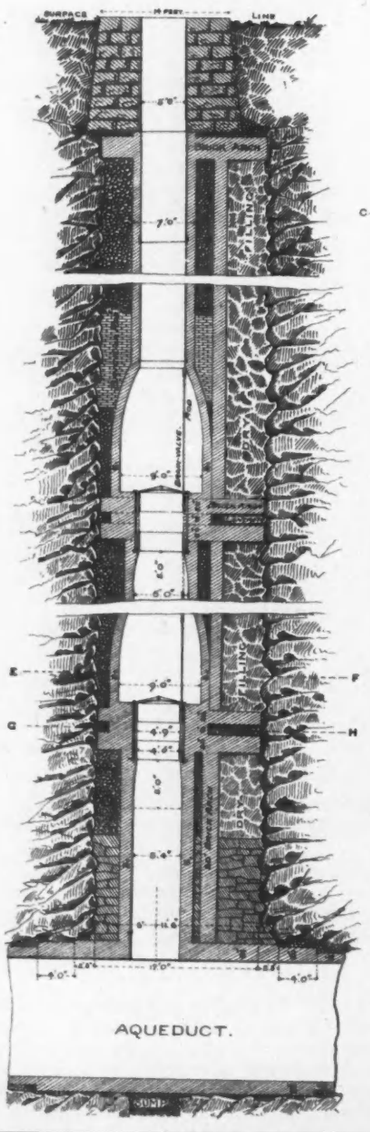
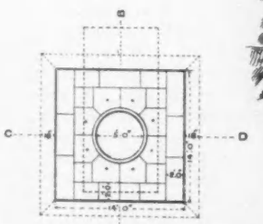
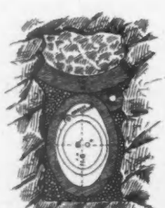




SURFACE PLAN.



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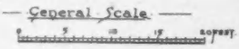
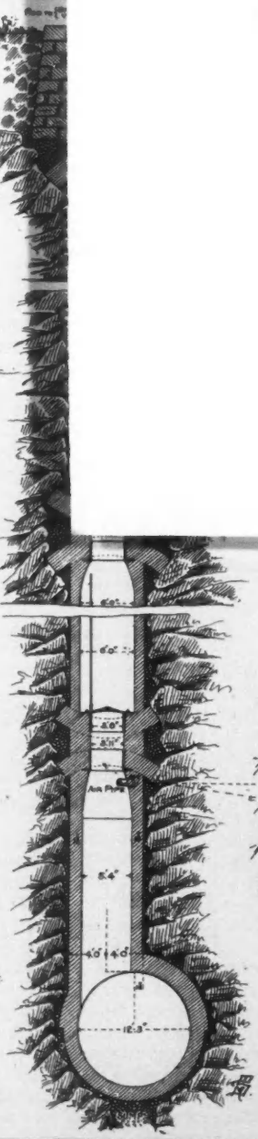
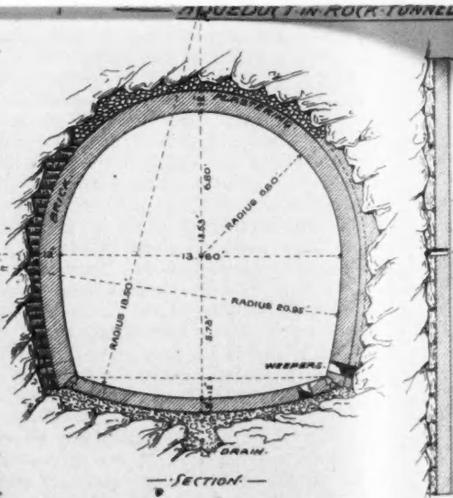
HOR. SECTION G H.

General Scale





AQUEDUCT IN ROCK TUNNEL



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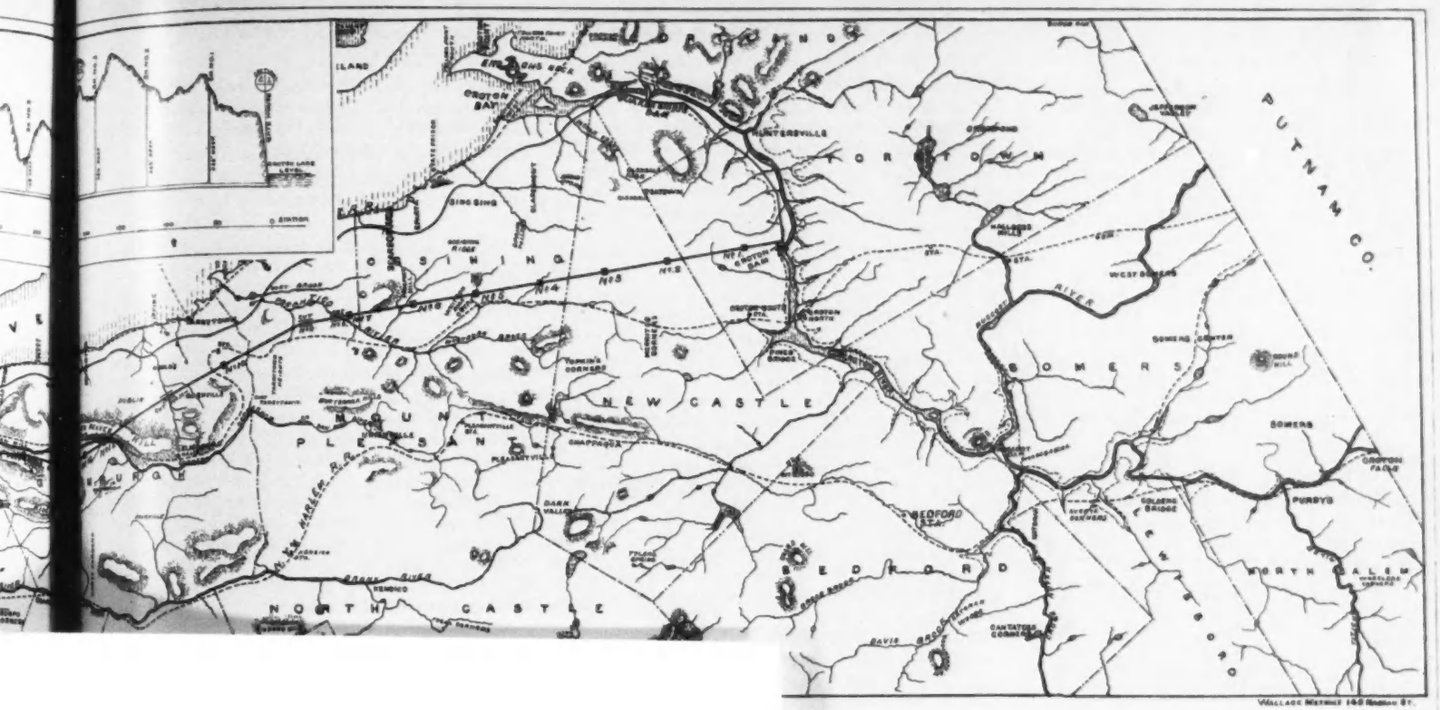
PUTNAM CO.
NEW CASTLE
SOMERS
BEDFORD
NORTH CASTLE
PLEASANTVILLE
MOUNT KISCO
GEORGE'S VALLEY
PURDYS
NORTH SALEM

On March 7, 1883, the Citizen Committee reported to the Legislature, and their recommendations may be summarized as follows:

1st. The present aqueduct can deliver no more than 95 to 98 million gallons daily.

2nd. A new aqueduct should be built immediately.

3rd. The Croton water-shed is the best source of supply to the extent of 250 million gallons daily in a dry season.

4th. The aqueduct should if possible be in rock and of a diameter of 15 ft. at least.

5th. Provision should be made for the ultimate storage of *all* the available water from the Croton Basin.

6th. Whether this storage, to the extent of 32,000 million gallons, shall be effected by means of a dam at Quaker Bridge, to be supplemented if need be by an additional reservoir in the water-shed above the present Croton dam, or whether reservoirs above the Croton dam shall be built from time to time as needed, was not determiued by the Committee; but they recommended that a Commission be appointed to consider and decide upon this and kindred questions, and to control the entire work.

The new aqueduct bill passed the Legislature on May 3, 1883, and was signed by the Governor on June 1; the work was to be conducted under a Commission, named in the act, as follows:—The Mayor and Comptroller of the City of New York and the Commissioner of Public Works, together with George W. Lane, James C. Spencer and William Dowd. (Mr. Lane having died since the passage of this act, Mr. C. C. Baldwin was appointed, about Feb. 1, 1884, to succeed him upon the Commission.) The act itself is too long for insertion, the sections regulating the engineering control of the work make it the duty of the Commissioner of Public Works to prepare and present to the Commission, from time to time all plans, specifications, etc., required, subject to acceptance, rejection or modification by the Aqueduct Commission.

Owing to the absence in Europe of one of its members, the Commission was not formally organized until August 8, 1883, and very soon thereafter Benjamin S. Church, long connected with the old Croton Aqueduct, was appointed Chief Engineer to the Commission, and later, A. Fteley, late Chief Assistant City Engineer of Boston was made Executive Engineer, and Joseph P. Davis, late City Engineer of Boston, the Consulting Engineer of the Aqueduct Commission.

It was supposed that active work would at once be commenced; but an element of delay, not anticipated, now presented itself with considerable force, and this was the opposition of the wealthy and influential landowners on the proposed route, which was by way of the North River directly to the Quaker Bridge dam. These parties not only objected to the running of a tunnel under their lands, though it was so far removed as to in no wise interfere with the surface embellishments, but also, as stated in their petition, to the "cutting up of the roads and travelled ways of the country, and the influx of laborers with the attending circumstances of drunkenness, noise, riot and other evils."

To meet this really vigorous opposition much time was expended in making new surveys and new plans, and the Commission abandoned the Quaker Bridge as a point of beginning for the new aqueduct, and determined to start directly from the Croton dam; the reasons given being that the latter point was preferable from a sanitary point of view, and that it was possible to thus increase the water supply of New York, to a degree at least, without waiting for the completion of the Quaker Bridge dam; the Croton line was undoubtedly longer but this additional length of aqueduct was considered as being outweighed by the other advantages mentioned. The first line surveyed on this new departure was common to the so-called North River line as far as Yonkers, when it took the Sawmill River valley, and following this finally reached the Croton dam by rather a circuitous route. This line upon examination, was rejected as involving possible obstacles to construction that would scarcely admit of estimation. A third line was now proposed, occupying the Sawmill River valley to a point east of Irvington, where it gradually approached the North River line and pointed towards the Quaker Bridge dam until near Tarrytown, where the direction again changed and the line ran straight to the Croton dam. This last is the adopted line and the one shown upon the map; it is 8,381 ft. longer than the route commencing at the Quaker Bridge, its total length from Croton dam to the crossing of the Harlem River being 148,692 ft., but it almost entirely avoids the shore of the North River.

The plans of tunnel shown are general plans as exhibited to the contracting parties, and are subject to such minor modifications as the service may require. Throughout its length the aqueduct is equivalent in flowing capacity to a circle 14 ft. in diameter, and the various sections are arranged to accord with this typical section. As drawn, the plans show three styles of arch-backing, that is, solid brick, rubble stone masonry or concrete; the nature of the ground passed through will determine which one is to be adopted in each case. A drain is to be cut below the floor of the excavation whenever, in the opinion of the engineer, special means are necessary for draining the tunnel during its construction for the proper protection of the masonry, and they are to be filled before the completion of the work. All masonry is to be laid in cement mortar, one part cement to two parts of clean sharp sand. American cement will be generally used, though Portland cement may be required at certain points. The concrete will be made of sound, broken stone, not exceeding 2 in. in diameter, and will be mixed with cement mortar, as above described, in the proportion of five parts of broken stone to one part of cement; for special cases a concrete of broken stone, 1 in. in diameter and mixed three parts of stone to one of cement, may be used. The bricks will be of the best quality of hand-made, hard-burnt bricks; they are to be laid radially and with no joint exceeding ¼ in. either in face or arch work; the inside faces are to be pointed with neat cement.

The shafts are to be 17 ft. 6 in. by 8 ft. in the clear, with the longest dimension parallel with the axis of the tunnel. Where the aqueduct is under pressure, as in the sections illustrated; special provisions are made in the man-holes for guarding against this upward pressure, providing drain-valves for emptying the shaft, and air-pipes for the escape of air during the refilling of the tunnel. The details of this construction are sufficiently shown on the accompanying plans.

Returning to the map and profile, it will be seen that there are 24 shafts shown, ranging from about 50 ft. to 350 ft. in depth; the various blow-offs and waste weirs at the low points in the profile are indicated, as are also the portions of the aqueduct to be executed in open cut. For construction purposes the entire conduit will be divided into seven divisions with an engineer and his corps over each division; Mr. H. S. Craven has been appointed Construction Engineer in general charge, and the permanent engineering organization is now being perfected.

The total area of the Croton Water-shed is 361.82 square miles, which will be entirely above the proposed dam at Quaker Bridge; there are only 338.82 square miles of water-shed above the Croton dam. The Croton is a river with wide fluctuations in its discharge: its daily flow at the present dam varying from 10,000,000, to over 8,000,000,000, of gallons; this wide variation explains the necessity for the immense storage capacity required to secure an adequate daily supply to the city. The storage capacity afforded by the proposed Quaker Bridge dam is about 32,000 million gallons, sufficient to insure a daily supply to the City of New York of 250 million gallons available for distribution.

A New Dredging Machine.

A new departure in dredging, and one which promises much in the form of results, is the pumping dredge now in successful operation at Coney Island, New York.

The application is entirely new and original with the inventor and patentee, Mr. G. F. Badger, Secretary and General Manager of the Pulsometer Pump Co., of New York. It consists in the main of a strongly built boat, supplied with suitable boiler power to run one or more pumps, steam hoists, winches, etc. Upon this boat is erected a heavy frame work about 25 ft. high, with strong cross-timbers at the top extending about 3 ft. beyond the sides and ends of the boat. Underneath these timbers and extending continuously around the boat are heavy iron channel-beams, curved at the corners, and forming with their lower flanges a track upon which runs a four-wheeled truck, the wheels being flanged. From the body of this truck is suspended the dredging pump—fitted with special valves for the work intended—by pulley blocks and chains, the latter running to the steam hoist inside the boat.

A suction pipe of iron extends down about 12 ft. below the pump, and to the bottom of this suction is attached a digging and straining device; the strainer, to prevent the entrance of any substance too large to pass the pump valves; and the digger is made of a series of vertical, sharp iron teeth, arranged in a circle around the bell-shaped mouth of the suction pipe, and intended to loosen up the sand, mud, clay, gravel, etc., to be raised. When the pump is lowered down to the bottom these teeth have upon them the entire weight of the pump, etc., about 2 tons, and with the oscillating movement given to them by the pump when in action, they will loosen almost anything they come in contact with.

The iron discharge pipe, flanged with gun-metal flanges, screwed and riveted, extends from the upper end of the pump to the rolling truck and through a strong collar attached to this truck from which the pump is suspended. The truck and pump are thus free to move to any desired point on the channel-beam track. At the top end of the discharge pipe is flanged a galvanized-iron "goose-neck," which leads from any point towards a central hopper from which last passes the trough for conveying the dredged material ashore. The sediment being discharged at a considerable height above the water, it is possible to deposit it either on a pile on the shore or convey it a distance of from 500 to 2,000 ft. from the boat; water pumped into the hopper may be used for aiding the flow if this is required.

The pump is operated by a steam pipe extending entirely around the boat and provided with suitable branches and valves at proper points. A water pipe also extends around the boat connected with a new Pulsometer in the hold of the vessel; this water pipe has appropriate branches and valves to which a strong conducting hose can be attached leading to the discharge cover of the pump. The purpose of this water pipe is to keep the lifted material in motion when from any cause the pump itself is stopped, and thus prevent the settling and packing of the sand, etc.

At Coney Island, where this pump has been at work, as much as 80 per cent. of sand has been raised, and no trouble has been found in making it average 50 per cent. of solids in the volume lifted. Any number of pumps can be used on one boat, and as each pump is capable of lifting 800 gallons per minute, the resulting work can be easily figured.

The Canal from Cronstadt to St. Petersburg.

This sea-canal was opened experimentally in the early part of October last. It has both stragetical and commercial importance, as opening direct communication between the port of Cronstadt and St. Petersburg for ships of war and large vessels generally. Heretofore the cargoes of all ships drawing more than 9 ft. of water had to be lightered up the 20 miles of shallow river to St. Petersburg.

The plan of the present canal was matured in 1872-73, and actual work was commenced in 1877. The canal is 17 miles long; the embanked portions are from 180 to 240 feet in width with an average depth of 20 feet. Messrs. Boreischa & Maximovitch were the contractors and the cost so far is 10.265.400 rubles.

African Railways.

At a late meeting of the Colonial Institute in London, the total length of government railway completed or in operation in the Cape Colony, Africa, was stated to be 1,500 miles. In addition to this mileage there are 60 miles of government line under construction; 42 miles of private line completed and in operation; 40 miles of private line under construction and 140 miles of mineral line from the coast to copper mines controlled by private parties. In the Colony of Natal there are 98 miles open for traffic and 116 miles under construction. This makes a total for South Africa of 1,744 miles in operation, and 216 miles under construction, including the mineral line above mentioned. This has practically been the work of ten years, and the total indebtedness of South Africa, £20,810,000, has been expended mainly for railways, harbors, telegraph and bridges. The European population is about one half million, say, 330,000 Dutch and 162,000 English.

The railways, both government and private, are solidly constructed on a 3 ft. 6 in. gauge, and are laid, 960 miles with steel and iron rails mixed, 45 lbs. to the yard, and the remainder with steel rails of 60 lbs. The main line extends from the Cape Town Docks, 570 miles north to the Orange River, 70 miles from Kimberley. The total cost of the 1,560 miles of government railway is £14,000,000, including rolling stock and cost of raising loans; of this amount £500,000 has been paid off by sinking fund and redemption to date, and £800,000 has been expended from revenue, leaving the liability to the public creditor on this account £12,700,000. The return for work in 1883 was 2½ per cent on the capital employed. Some £400,000 has been spent in bridge building.

Spongy Iron as a Filtering Medium.

We are indebted to Mr. Emil Kuichling, of the Rochester, N. Y., Water Department, for several pamphlets upon the use and value of Spongy Iron as a filtering medium for water intended for domestic purposes, and also for clarifying sewage.

The pamphlets referred to are sent out by The Spongy Iron Filter Co., of London, England, but the testimonials and reports contained in them embrace much matter of interest from undoubted authority, and from these we make the following abstracts:

The purifying effect of spongy iron on water has been known for some time; but Professor Bischof and Mr. F. Hatton have also determined, experimentally, that in addition to the chemical purification of water, this material possesses the property of destroying germ life in water. This later discovery is of incalcuable interest and value at the present moment, with the scientific world busy in the investigation of the bacteria and other germs injurious to human life, and disease chargeable to these causes devastating portions of Europe.

Spongy iron, although used for some years in domestic filters, has only lately been applied on a large scale. In constructing the Antwerp Water Works, Messrs. Easton & Anderson were met with the difficulty of filtering what in its natural state is a very impure water. Sand filtration proved inadequate, and it was concluded to try the spongy iron and the filters established on this system have been in very successful operation since June, 1881. The filters are planned to treat over 2.000.000 gallons of water daily.

From a report by Dr. Frankland, F. R. S., "On the use of Spongy Iron in the Filter Beds of the Antwerp Water Works," we obtain the following data: The water is taken from the River Nethe, 15 miles above Antwerp, and is first impounded in too subsiding reservoirs, where it is allowed to stand from 12 to 24 hours; from these basins it is pumped on the spongy iron filters, whence it flows by gravitation upon sand filters,

The spongy iron filters consist of two layers of brick loosely laid upon a bed of concrete. On the bricks rests a layer 3 feet in thickness, formed of 5 milimetre gravel mixed with one third of its bulk of spongy iron, one-fourth of the filtering mixture thus being spongy iron. Then comes a layer of three inches of fine gravel, and lastly a stratum of sand two feet deep, making in all five feet three inches of filtering material.

The sand filters are similarly laid upon bricks and concrete. They consist of a layer of 5 millimetre gravel, one foot thick, covered with 3 inches of fine gravel and topped with 2 ft. 6 in. of sand, making allogether 3 ft. 9 in of filtering material.

The area of filtering surface of each filter amounts to 7,302 square feet, and the rate of filtration varies from 300 to 500 gallons per minute, or 60 to 100 gallons per square foot per 24 hours.

In analyzing the water of the Nethe, it was found that even after 24 hours subsidence the water was still very impure, highly charged with nitrogenised organic matter; 100.000 pounds of it contained, as it passed to the spongy iron filter, 21 lbs of solids, mostly in solution. The hardness was 11.5,° of which 4.6° were removed by boiling the water for half an hour, The organic matter present in the before mentioned quantity of water contained 0.623 lbs. of carbon and .219 lbs. of nitrogen; the same weight of water also contained .028 lbs. of ammonia and 1.8 lbs. of cholorine in the form of chlorides, the total amount of nitrogen in all forms amounting to .243 lbs. There was no evidence of previous sewage contamination, but in this condition the water was exceedingly unpalatable. The aggregate effect produced by one filtration through spongy iron, followed by one through sand was as follows:—

	Total percentage reduction
Total solids	41.3
Organic carbon	60.9
" nitrogen	74.9
Ammonia	
Total combined nitrogen	77.3
Chlorine	0.
Temporary hardness	13.0
Permanent "	35.3
Total "	27.0

The nitrogenous character of the organic matter was diminished from the initial proportion nitrogen to carbon = 1 : 2.84 down to 1: 4.4. And lastly, from being muddy, unpalatable, colored and polluted, the water of the Nethe was rendered colorless, bright, palatable and fit for all dietetic and all domestic purposes.

Professor Bischof (Proceedings of the Royal Society XXVII, p. 258) proves that water that has passed through spongy iron is entirely free from bacterial germs; and Mr F. Hatton, in the laboratory of Dr. Frankland, proved that spongy iron was the only known substance applicable to the treatment of large volumes of water which immediately destroys living bacteria (*Jour. Chem. Soc.* vol. XXXIX p,247.) Mere sand filtration, even of the most perfect kind, affords no such guarantee; for it was proved at Lausen, Switzerland, that water containing typhoid germs infected the population of a village and destroyed many lives after it had been subjected to a very efficient sand filtration.

The manager and resident engineer of the Antwerp water works testify that they find no difficulty in working the filters, and the water gives great satisfaction to the consumers. The effect is also beneficially in the water used in boilers.

PERSONAL.

CHARLES KING, one of the engineers of the Oriental Construction Company, engaged in railroad building in Mexico, died on Monday at Los Angeles, Cal. He was the son of Chas. King, an old New York merchant, and was born in New York. He was 29 years old. He was a graduate of the College of the city of New York He first engaged in the mercentile trade but on account of his health gave it up for engineering.

OBITUARY.

SAMUEL HENRY SHREVE died at his residence in New York City on November 27th. Mr. Shreve was born in Trenton, N. J., August 9, 1829, being the eldest son of Samuel Shreve; he graduated at Princeton College in 1848, and in 1850 from the Harvard Law School. His tastes however, lead him in the direction of civil engineering and he soon adopted that profession. He was in later life especially identified with rapid transit in both New York and Brooklyn, and with the late Isaac Newton was engineer of the Rapid Transit Commission; he was consulting engineer of the Metropolitan Elevated Railway during its construction and chief engineer of the Brooklyn Elevated Railway now nearly completed.

MR. SHREVE was elected a member of the American Society of Civil Engineers, on May 19, 1869, and was the author of a well known work on "Bridges and Roofs," and at the time of his death had nearly completed an exhaustion treatise an the "Theory of the Arch.', Mr. Shreve was buried at Springfield, N. J. where his ancestors for nearly two hundred years have been laid at rest.

Ventilation in the Arlberg Tunnel.

The question of ventilation was one of the highest importance and it became the subject of careful study. The experience at the St. Gotthard had demonstrated the insufficiency of the means there employed and showed the necessity of adopting some other method of procedure. In the Swiss tunnel, the air escaping from the drilling machines and from valves at intervals upon the compressed-air conduit was depended upon for ventilation. This system failed from the insufficient area afforded and from the fact that the workmen often tampered with the air-pipe for the purpose of obtaining a further supply of fresh air, thus diminishing the pressure at working the face and interfering with the efficiency of the drills. The defective area in this manner acted injuriously both upon the progress of the work and upon the health of the workmen.

In considering the duty to be performed by compressed-air two facts became apparent, first, that a pressure of 5 to 6 atmospheres is necessary for the work of drilling, and second, that the air destined for ventilation should simply be abundant. When these conditions are fulfilled the health of the men is better and the work is advanced satisfactorily. These considerations lead towards the employment of two distinct air conduits, the one carrying air at a high pressure for the drilling machi-

nery, the other conveying air of light pressure for ventilation only.

The contractors of the Arlberg tunnel were compelled by the terms of their contract to furnish each working face with a minimum of 153 cubic metres (5,401 c. ft.) of air per minute, and carry the end of the ventilating conduit to within 100 metres (328 ft.) of the tunnel head. This conduit had a diameter of 15¾ in. on the east side and 19.7 in. on the west. They carried the compressed-air to all the "chambers of enlargement," which, thanks to the efficient organization of the work, were concentrated within a distance of 500 *m* (1,640 ft.) back of the working faces of the tunnel.

Further than this, the conduit conveying the hydraulic power to the Brandt drills on the west side, was also of considerable value in ventilating the tunnel. With it the heading was sprinkled with water after each explosion; the fine spray projected with great force mingled with the gases of combustion and precipitated the dust and smoke and permitted a more rapid return of the workmen into the heading. This artificial shower also lowered the temperature. Appreciating these advantages, the contractors established from each end of the tunnel conduits for water under pressure, intended to furnish the water necessary for this sprinkling process and at the same time supply the men with this needed fluid. This conduit, on the east side, also furnished the water for cleaning out the holes made by the Ferroux drills, and made unnecessary the attendent usually appointed to this duty. As a result of the system adopted, there were, on each side, three distinct conduits; the first carrying the force required as a motor; the second, air at a low pressure for ventilation, and the third, water for sprinkling and drinking purposes. By this arrangement the different services were independent of each other and were in the best condition for effectual work; and combined, they form another and strong argument for the "bottom header" system of advance.

The vitiated air was withdrawn, at the Arlberg, by a bratticed gallery in the upper part of the tunnel, and by openings which connected the gallery with the lower parts of the tunnel, which latter served also to discharge the debris. It filled the office of a conduit of aspiration in the crown of the tunnel-arch.

For ventilating machinery, they used, on the east side, blowing machines with a piston 3.77 ft. in diameter, 3.28 ft. stroke and making 30 double strokes per minute; these machines carried 6,354 c. ft. of air per minute a distance of 19,680 ft. At the west end, six small centrifugal blowers were employed, 5½ ft. diameter and making 1,500 revolutions per minute; these were grouped one over the other in such manner that No. 1 forced its air into the mouth of No. 2 and so on, augmenting the pressure at each blower, the last one transmitting 5,295 c. ft. of air a distance of 13,120 ft. In addition to these a group of ventilators operated by a turbine of 50 horse power was put into service in 1882.

This entire installation has given most excellent results and there has been literally no accidents chargeable to vitiated air as there were at the St. Gotthard where the ventilation was insufficient.

The entire plant was erected partly by the contractors, and partly by the Administration of the railways of Austria, or under its direction. The water conduits, roads of approach, workshops, barracks for workmen, hospitals, etc., enter into this category. These structures were given gratuitiously to the contractors, in place, but they were held responsible for them, war excepted.

The end aimed at by the Administration was the avoidance of any delay due the tardiness of the contractors, and to enable them to so manage their services that actual work upon the tunnel would be continuous.

Le Génie Civil

TRACK.*

BY W. B. PARSONS, JR., C. E.
ROADMASTER SUSQUEHANNA DIVISION ERIE R. R.

(*Continued from page 260.*)

Cross-section.—In arranging the shape of the ballast and road-bed, and manner of putting up the track every care should be given to drainage. Unfortunately for good track the importance of this subject is frequently underrated. "Take care of the ditches and the track will take care of itself" might almost be made an axiom; at any rate it can be laid down as a law that no track can be good without drainage.

Ditches should be full and ample to carry off the greatest amount of water that can come into them even at heavy rainfall, with the bottom sufficiently below the ties so that the moisture will run from them and keep the ballast hard and compact. The contour of the ballast should be such as to give a perfect support to the tie; keep it from movement either laterally, longitudinally or vertically; and to obtain this it is necessary to keep it dry, therefore it must be shaped so that it will not retain water. Fig. 28 shows cross-section of single track with "mud" ballast. The efficacy of mud depends entirely on drainage. Let water soak into it and it immediately becomes pasty—so that one day's rain may ruin weeks of patient surfacing. Therefore the ditches must be low, the lower the better, the bottom of which should be at least 20 in. below the tie and if the cut is 18 ft. wide this will bring the lowest part, i. e. where the slope of the ballast meets the bank, 4 ft. 9 in. from the end of the tie.

In the center of the track the mud should be heaped up about 2 in. above the top of the tie and then rounded off on both sides to the bottom of the end of the tie, leaving the whole end exposed. This crowning is done to run the water off quickly. Care should be taken to see that it is properly carried out, that the curve of the crown is such as to leave 1½ in. under the rail, and that the end of the tie is not buried at all. If it is, then under action of trains in wet weather it will work a trough which will retain water, and the consequent softening of the mud allows the track to settle. If the tie is exposed at the end, the water that is on top runs off while any that soaks down underneath has an opportunity to run out. From the ends of the ties the mud must be sloped away until it reaches the bank as shown. No shoulder or anything that will retain water is required and therefore is to be avoided. An example of this unnecessary shoulder is given in Fig. 29 showing standard of the Erie and Wyoming Valley R. R. Everything should be done with the aim of facilitating the passage of water into the ditches. While this arrangement is not guaranteed to give perfect track with mud, it is certainly the best scheme to take care of bad materials; for while drainage is essential to all track no matter how good the ballast, it is the entire life of and sole hope for "mud."

With gravel or cinder ballast the conditions are somewhat modified. In construction the road-bed at sub-grade should be crowned 8 in. as shown in Fig. 28. Then the ballast at the thinnest point in the center should be 12 in. deep, thus making the bottom of the tie 1 ft. 8 in. above the ditch. Between the ties the ballast should be filled even with the tops of them, it not being necessary with good ballast to raise it above the ties as with mud, then level for about 3 ft. and round it off under the rail to the tie ends leaving them bare as before; thence it should be carried with a regular slope of 2½ to 1 until it meets the sub-grade. Water thus has a free and uninterrupted course from the center of the track into the ditch. With stone ballast these conditions are still more varied. We are now dealing with a material through which water runs with perfect freedom, therefore the cross-section recommended for previous cases needs to be considerably changed. The sub-grade should be constructed as for gravel upon which the stones should be placed 12 in. in depth in the thinnest part. Each stone should be so broken as to pass in any direction through a 1½ in. ring and be as uniform as possible. Inasmuch as water will run through and not off the broken stone, it is not necessary to crown it when filling in between the ties. On the contrary it should be carried out flush with the top of them as far as the end and then rounded off neatly as shown in Fig. 28.

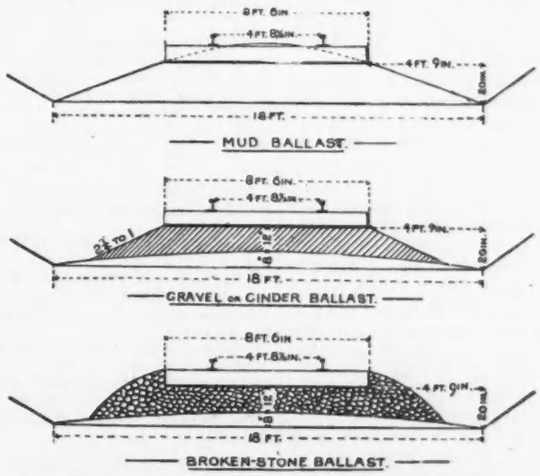

FIG. 28.—N. Y., L. E. & W. R. R. STANDARD SINGLE TRACK.

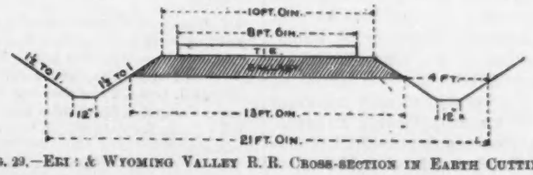

FIG. 29.—ERIE & WYOMING VALLEY R. R. CROSS-SECTION IN EARTH CUTTING.

The tie thus receives better protection from fire and damage by derailment, but more important still the track is kept in better alignment. The tendency to work out of line is greater with stone than with gravel unless the stone is finely broken, for though the sharp corners may eat into the wood, yet, if the ballast is coarse the tie is held upon a few points on which it rocks to and fro.

(TO BE CONTINUED.)

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Engineers Club of Philadelphia.

At the regular meeting of November 15th, Mr. John Haug, presented a description, illustrated by drawings and test specimens, of Mr. Wm. Astor's new steam yacht, the first seagoing steamship built of steel in this country. The plating used was furnished by the Danville Iron and Steel Co. of Danville Pa., and had a tensile strength of from 62,000 to 72,000 lbs. per sq. in. with an elongation (in 8 in. length) of from 20 to 24 per cent. Mr. Fairman Rogers described the steam-yacht "Magnolia," built in 1882 by the Herreshoff Man. Co., Bristol, R. I.

Mr. E. F. Smith presented an illustrated description of a floating coffer-dam, used in removing obstructions from the channels of the Schuylkill Navigation Co. Its dimensions are 32 ft. by 48 ft., and 20 ft. by 35 ft. formed by the union of two halves which when placed end to end could pass through the canal locks. It has water-tight boxes to float it and to hold stone to sink it. When in use it is surrounded by sheet piling and the latter by puddle clay. It has been worked in 7½ to 11 ft. of water; cost $1,128.32 in 1879, and requires 7 men to shift it, in four to six working days.

Mr. Theodore Bergner exhibited his designs for Drawing Boards. Mr. Robert P. Snowden presented an illustrated mathematical discussion on Formulæ for Frogs and Switches. Mr. Graham Spencer described the Kaolin beds of Chester, Pa. Mr. Allen I. Fuller exhibited a new form of Transit Rod, made so that the point of the shoe is in the same plane as the face of the rods; an opening in the rod from 9 in. above the shoe to a height of 6 or 7 ft. permits the use of a suspended plumb, with a marked cross-piece near the bottom of the rod. The transitman sights to this plumb-line. Mr. R. H. Soule presented notes upon the West Shore Anthracite Engine, No. 24, 8 wheeled. Mr. Bugbee Smith described the method of removal of the West Philadelphia Stand Pipe, taken down in 1881, and its re-erection at Spring Garden. The pipe was 156 ft. high, as rebuilt, and 5 ft. in diameter, and was raised in one piece by means of two shear-poles in 1 h. 40 m.

American Society Civil Engineers.

At a meeting held at the House of the Society on the evening of Dec. 3, Vice President Wm. H. Paine, presiding, the following persons were elected to the several classes as given below:

MEMBERS: Frederic Vaughan Abbot, 1st Lieut. Corps of Engineers, U. S. A., Fernandina, Fla.; Henry Smith Craven, Civil Engineer, U. S. N., Engineer of Construction, Aqueduct Commission, Tarrytown, N. Y.; James Dudley Hawes, Chief Engineer Michigan Central Railway, Detroit Mich.; John Thomas Henthorn, Engineer in Charge, Works of Geo. H. Corliss and Corliss Steam Engine Co., Providence, R. I.; Frank Wellington Hodgdon, Assistant Engineer Harbor and Land Commissioners, Boston, Mass.; Charles Vernon Mersereau, U. S. Assistant Engineer, St. Louis, Mo.; Albert Franklin Noyes, City Engineer, West Newton, Mass.; Pedro J. Sosa, Chief of Hydrographical, Topographical and Locating Departments of the Panama Canal, Panama, U. S. of Colombia; Charles Jeptha Hill Woodbury, Mechanical Engineer, Boston, Mass.

JUNIORS: Loomis Eaton Chapin, First Assistant City Engineer, Toledo, Ohio; Harold Edward de Raasloff, Civil Engineer, New Tacoma, Washington Territory; Roger Tappan, Civil Engineer, Haverhill, Mass.

The principal business of the evening was the discussion of the paper on *Experiments with new Apparatus in Journal Friction at Low Velocities* read by the author, Mr. A. M. Wellington, at a late meeting. This discussion was of an exceedingly interesting nature and was participated in by Prof. R. H. Thurston, D. J. Whittemore, J. W. Cloud, Mr. Tower of London and others through the Secretary, and by Messrs. Cooper, Emery, Collingwood, Paine and Mr. Wellington personally.

Sig. Felice Cicconetti, a distinguished architect of Rome, presented to the Society an interesting collection of Building Materials as used in ancient Rome, including specimens of tufa, brick, mortar, concrete etc., among them fragments from the Cloaca Maxima, dating from the time of the Republic.

The death of Samuel Henry Shreve, elected member May 19, 1869, was announced by the Secretary.

WATER.

OPERATIONS on the Houghton, Minn., water works have ceased for the winter.

FILTRATION OF WATER.

OFFICE OF THE CITIZENS WATER & GAS COMPANY,
WILLIAMSPORT, PA., NOV. 29, 1884.

ED. ENGINEERING NEWS.—I desire to obtain all the practical information I can on the subject of water filtration, and would like a list of places where the system is in use. Very respectfully,

J. H. MCMINN.

The most complete summary of information regarding filtration in the United States is contained in the paper read by Mr. Croes before the American Water Works Association at Buffalo, in May 1883, and published in their "Proceedings," which can be obtained from J. H. Decker, Secretary Am. W. W. Ass. Hannibal, Mo. This paper was printed in ENG. NEWS, of June 16, 1883.

THE ASHLAND WATER COMPANY, of Ashland, Wisconsin: President's Office, Post Office Box No. 9, Louisville, Ky.

Board of Directors: Samuel A. Miller, Vice President Dennis Long & Company, Louisville, Ky., *President.*

T. T. Flagler, President Holly Manufacturing Company, Lockport, N. J., *Vice President.*

William Tillman, Cashier Falls City Bank, Louisville, Ky., *Treasurer.*

S. S. Vaughn, Real Estate Dealer, Ashland, Wis.

William M. Tomkins, Attorney at Law, Ashland, Wis.

P. N. Linneen, Holly Manufacturing Company, Lockport, N. Y.

Wm. Reinecke, Attorney at Law, Louisville, Ky. *Secretary.*

THE FRANKFORT WATER COMPANY, of Frankfort, Kentucky: President's Office, Post Office Box No. 9, Louisville, Ky.

Board of Directors: Samuel A. Miller, Vice President Dennis Long & Company, Louisville, Ky., *President.*

J. Stoddard Johnston, Editor "Frankfort Yeoman," Frankfort, Ky., *Vice President.*

George J. Long, Secretary and Treasurer of Dennis Long & Company, Louisville, Ky.

Daniel W. Lindsey, Attorney at Law, Frankfort, Ky.

Clifton Rodes Barret, Louisville, Ky., *Treasurer.*

THE OWENSBORO WATER COMPANY, of Owensboro, Kentucky: General Manager's Office, Post Office Box No. 9, Louisville, Ky.

Board of Directors: Dennis Long, Dennis Long & Company, Louisville, Ky., *President.*

John G. Barret, President Citizens National Bank, Louisville, Ky., *Vice President.*

Samuel A. Miller, Dennis Long & Co., Louisville, Ky., *General Manager.*

H. C. Rodes, Cashier Citizens National Bank, Louisville, Ky.

William T. Sweeney, Attorney at Law, Owensboro, Ky.

Philip T. Watkins, Cashier First National Bank, Owensboro, Ky.

Wm. Reinecke, Attorney at Law, Louisville, Ky., *Secretary.*

THE DANVILLE WATER COMPANY, of Danville, Illinois: President's Office, Post Office Box No. 9, Louisville, Ky.

Board of Directors: Samuel A. Miller, Vice President of Dennis Long & Company, Louisville, Ky., *President.*

George J. Long, Secretary and Treasurer of Dennis Long & Company, Louisville, Ky.

John Long, Sales Agent of Dennis Long & Company, Louisville, Ky.

Wm. P. Cannon, President Second National Bank, Danville, Ill.

J. C. Black, Attorney at Law, Danville, Ill.

Carroll E. Gray, Contractor, St. Louis, Mo.

Wm. Reinecke, Attorney at Law, Louisville, Ky.

C. R. Barret, *Treasurer.*

THE WYANDOTT WATER-WORKS.—We announced last week that Mr. Johnson, receiver of the Marine Bank of New York, had as such receiver disposed of the liens held by said bank on the Wyandott and Armourdale water-works, and that as soon as the preliminaries were arranged the purchasers would take possession of the works.

The gentlemen financially interested in the purchase are Mr. S. D. Loring, of Boston, and Dennis Long, Samuel A. Miller and Geo. J. Long, of Louisville, Ky. Mr. Loring, we understand, is a capitalist and banker, and the other gentlemen run one of the largest establishments for the manufacture of gas and water pipes and branch castings in the United States.

Last week the purchasers took formal possession of the works and installed Mr. Geo. B. Sidelinger, of Rockport, Maine, as Superintendent. We are informed that the intention of the purchasers is to consolidate the two companies and organized a joint stock company under the general incorporation laws of Kansas.

The gentlemen will find the plant a valuable one. Our judgment is that the two franchises alone are worth more in good hard cash than they paid for the whole concern, but that matters little. We regret that the works had to change hands, but from the hour of the failure of Grant and Ward we knew it was inevitable. There is great consolation in the knowledge that the works could not have fallen into better hands. The gentlemen who have made the purchase are not only able to hold them without incumbrance, but are practical men who understand the situation, are able and will make extensions just as fast as public necessity demands them.

The new superintendent, Mr. Sidelinger, has all the vim and energy peculiar to New Englanders, and from what we have already seen of him we are satisfied the new company will have no occasion to regret placing him a position filled with so many responsibilities.—Wyandott *Herald*, Nov. 20.

THE Crookston, Minn., water-works are to be purchased by a private corporation.

MESSRS. INGLIS & HUNTER of Toronto, Canada, are building some large pumping engines for the city water-works.

ACCORDING to the annual report of the Water Works Committee, which was submmitted at the council of Ottawa, Canada, recently, the direct annual benefit to the city is about $34,000. The total receipts from water rates were $104,000 and street sprinkling $6,000, making in all $110,000, against $99,000 in 1883. The expenditure amounted to $94,000.

THE A. S. Cameron Steam Pump Works of New York, have just received notice that the Managers of the Louisville Industrial Exhibition, had granted them a Diploma and Medal of highest award. The Cameron Steam Pump, during a history of a quarter of a century, have been thus honored more than once for every year of its manufacture.

THE following extraordinary communication startled the Aldermen of the City of New York, at their meeting of Dec. 1; it was referred to the Committee on Arts and Sciences:—

236 THIRD AVENUE, NEW YORK CITY,
November 29, 1884.

THE HON. BOARD OF ALDERMEN, CITY OF NEW YORK:—

GENTLEMEN—I have the honor to request that a committee be appointed to investigate means which I propose—D. V.—to supply this city with water from the atmosphere at a merely nominal expenditure. A rough estimate lately made only required $30,000 for appliances to furnish say 50,000,000 gallons daily. Patent applied for. It will expedite the business if one or all of the following named gentlemen be present:—Professors Draper, Compton and Doremus, some medical officers of the Health Department, and the City Engineer; also, if convenient, that the committee have studied elementary physics.

As the earth, with all its inhabitants, is in imminent danger of physical destruction, Peter II., iii., being about to be fullfiled, the frequent earthquakes being the premonitory physical signs and symptoms of the impending conflagration, and as the means I propose, generally applied, will arrest (D. V.) the destruction, no delay can be allowed, if you desire to save your own and fellow creatures' lives. (Signed) Michael Cahill, M. D.

NEWS OF THE WEEK.

Railroads and Canals.

Brenham, Tex., is to have a street railway.

THE Brooklyn Elevated Railroad Company hopes to get a portion of its lines in running order by February first, and the remainder by April.

THE Wichita and Western road will be extended west from Wichita to Saratoga, Kansas, and eventually to Dodge City.

MARSHALL, TEX., November 28.—The project of building a narrow gauge road from this city to intersect the Texas and St. Louis near Pittsburgh has been revived.

DUBUQUE, Io., November 28.—Work on the Winona, Alma and Northern Railroad, in the vicinity of Potosi and near the mouth of the Platte River, will be carried on on an extensive scale this winter. E. P. Reynolds & Co., the contractors, have one of the largest camps ever located in this section. The principal work to be done this winter is riprapping along the newly constructed bed, while several cuts at points where the bluffs rise abruptly will furnish abundance of work during the winter. Blanding & McCormick have finished their sub-contract near Sinapee Creek.

IT is stated that W. A. Cowan, Chief Engineer of the Hannibal and St. Joseph road, with a surveying party, is looking out a route for an extension of that road into the country now occupied by the Manitoba road.

THE directors of the proposed Springfield, Shelbyville and Mount Carmel Railroad have decided to make a survey and locate the line at once. Captain Howard of Effingham, Ill., is chairman of the board of directors.

MR. JOHN C. GOODRIDGE, of New York, is now in Kansas City preparing to make some repairs by the use of his artificial stone to the masonry of the railroad bridge across the Missouri River at that point.

DOVER, N. H., Dec. 4.—The last spike connecting the Eastern and the Boston and Maine Railroads in this city was driven this evening, and the rails are now ready for business from the Boston and Maine station over either road.

PITTSBURGH, Nov. 26.—Surveys are now being made looking to the extension of the Waynesburg and Washington Railroad in two directions south of Waynesburg, in Greene County. One of the proposed lines is to Jefferson, Pa., and the other to Blacksville, W. Va.

THE great success of the railways already built in Japan has led to the formation of several additional companies. An extensive network of lines will be constructed. The Government is anxious to keep the control of the lines in its own hands.

THE Houston and Texas Central railway has let the contract for the immediate extension of its line from Albany (Shackelford county) to a connection with a Denver and New Orleans road at some suitable point in its course not yet definitely determined upon.

THE first sod on the route over which the Thunder Bay Colonization railway will pass was turned on Saturday, Nov. 22nd, in Port Arthur. The road is intended to be a southern outlet for Canada into American territory, giving Port Arthur direct communication with St. Paul, Minneapolis, and the wheat fields of Minnesota.

ROGERS AND BALLENTINE have closed a contract with the Cincinnati, New Orleans and Texas Pacific system, to rebuild that portion of the V., S. and P. road between Monroe and Delta, or, in other words, to place it above overflow. The contractors will raise the roadbed from Monroe to Delta from 4 to 10 ft., and will also put in two or three miles of bridging.

MONTREAL, Nov. 27.—A cablegram has been received from England by the Canadian Pacific Railway, stating that financial arrangements have been completed for the immediate construction of a line from Smith's Falls direct across the country to Montreal. The road, which at the former place would join the Ontario division and would first meet the Grand Trunk line at Ste. Annes, where the river would be bridged. The object of the proposed lin eis to make a more direct line to Toronto and the West, thus avoiding the necessity of traffic passing around by Ottawa.

RALEIGH, N. C., Dec. 3.—A company composed of Boston capitalists have contracted to build a wide-gauge railroad from Gaffney, on the Atlanta Air Line Road, to Rutherfordton, by the 1st day of next October. The county has voted a subscription of $100,000 in 6 per cent. bonds, payable in 30 years. Surveyors are now locating the road. The same company contemplates extending the road from Rutherfordton through McDowell and Mitchell Counties to Johnston Station, on the Norfolk and Western Railroad. Mitchell county has ordered an election on the 16th of this month upon a proposition to subscribe $100.000 in bonds for this purpose.

ARTICLES of incorporations for the Independence and Verdigris Railroad have been filed with the Secretary of State of Kansas, providing for the construction of a standard gauge road from Independence, Montgomery County, to Emporia, Lyon County, with a branch running from Altoona, on the main line, to Chanute, in Neosho County, and a branch from Virgil, another point on the main line to Burlington, Coffey County. The number of miles of road to be built, including branches, is 260, for which a capital stock of $1,000,000 has been formed. The Directors are G. W. Donaldson, William Otis, A. C. Stitch, J. M. Anderson, M. H. Stahl, E. T. McFarland, P. V. Hackett, John Filkins, and Henry Foster, all of Kansas. The place of business of the road will be at Independence, and the counties through which the proposed road shall run are Montgomery, Wilson, Woodson, Greenwood, and Lyons.

SPRINGFIELD, MO., November 25.—James Reilly has finished grading his first one mile contract on the Kansas City, Clinton and Springfield Railroad, between Humansville and Ash Grove. Five contractors in all are engaged, two north and three south of Clinton, their forces being scattered over 64 miles of road. The 49 miles from Raymore, the terminus of the Pleasant Hill Branch, purchased by the Santa Fe, to Clinton will be graded in less than thirty days, and track laying will be commenced by the middle of December. This division of the road will be finished by the 1st of February, and the new line will then be operated between this city and Clinton, and work will be continued south of Clinton, and will be completed by June or July.

COL. GEO. YOUNG, General Manager of the St. Joseph and Rio Grande Railroad, states that active operations will commence as soon as the ground breaks up in the spring. It is estimated by competent authority that the new lines built in 1884 aggregate 4,000 miles in length, and there are preparations in progress for an increased extent of construction in 1885, extending, it is asserted, to 6,000 miles, which will probably expand to nearer 8,000 miles. In 1883 there were 6,753 miles of new railroad laid, which was a great reduction on the work of 1882, which comprised 11,596 miles. The second year of our decade, 1881, represented 9,789 miles. For thirty years previous to that date the rate of annual progress had varied from 1,000 to 7,000 miles. In the item of steel rails it is stated that the balance of this year calls for 150,000 tons.—*Philadelphia Railroad Recorder.*

SAYS the Aspen *Times:* "Professor Wigglesworth, the Chief Engineer in charge of the Colorado Midland Railroad survey, was in Aspen Sunday, on his way to Colorado Springs. He has a force of ten men on the survey, who have reached a point on Frying Pan Creek about fifteen miles from its mouth. The grade established on both sides of the continental divide is 2½ per cent., or 132 ft. to the mile, which is a very practicable grade. The tunnel through the apex of the divide will be 2,136 ft. long. Professor Wigglesworth says the road should be built from Leadville to Aspen before it is built from Colorado Springs to Leadville. The road can be built from Leadville to Aspen within two months, the only hindrance being the finances of the company. If the company can succeed in raising the funds, Aspen will soon have a railroad that will take the Roaring Fork Valley at the mouth of Frying Pan and proceed up to Aspen, also to the coal fields and Grand Junction. With a road from Leadville to the coal fields, Crested Butte would lose the Leadville market for coke and coal. It will take about one month to complete the preliminary survey to Aspen."

A NEW SOUTHERN LINE.—RALEIGH, N. C., Dec. 2.—A glance at the map shows a gap in a through line of railway from New York to New Orleans from Hamlet, in this State, to Cheraw, in South Carolina. The through lines in this State are by way of Greensborough and Charlotte and by way of Weldon, Goldsborough, and Wilmington. Raleigh has always been upon a side track, and has never received any of the benefits of the Florida travel during the winter months, nor of the fast mail. The managers of the seaboard system of railroads have not attempted a through line by Raleigh, and one to Charlotte over the Carolina Central, because they have no outlet at Charlotte, both roads at that point being under the control of the Richmond and Danville Company. The road from Richmond to Weldon is run in connection with the Atlantic Coast line, so that it has been impossible to have a through line by way of Raleigh without building a new road from Richmond direct to Ridgeway, on the Raleigh and Gaston Railroad, and then by filling in the gap from Hamlet to Cheraw. Moncure Robinson has a charter for the Virginia and Carolina Railroad authorizing the construction of a road from Richmond to Ridgeway, and has been rapidly building this line. He has also a charter for the Palmetto Railroad, and has been constructing a road from Cheraw to Hamlet. The grading is done from Richmond to Ridgeway, and the bridge across Roanake River is very far advanced. The grading from Cheraw is completed and the road is ready for the iron. Both companies have ample means and both connections will be made by June next. When all the connections have been made a through line from New York by Washington to Richmond, thence to Ridgeway over the Virginia and Carolina Road, thence to Raleigh over the Raleigh and Gaston Road, thence to Hamlet over the Raleigh and Augusta Road, thence to Cheraw over the Palmetto Road, and on to Charleston and to New Orleans will be opened. This line will be shorter than by Wilmington, and the people along the line from Ridgeway to Hamlet expect great benefit from its establishment.

PITTSBURG, Penn., Dec. 4.—The report that the Eastern furnacemen contemplate a reduction of $1 per ton in order that they may compete with the Southern furnaces is causing much uneasiness among the Pittsburg iron men, who say that if the reduction is made they also will be compelled to make a reduction in order to hold their trade.

TABLE showing miles of railroad in operation in the Republic of Mexico on Oct. 1, 1884, from a Paper entitled "The Mexican Railway System," by Emile Low, C. E.

NAME OF R. R. IN OPERATION BETWEEN POINTS AND MILES.	
Mexican Central.	
Paso del Norte to Mexico	1,224
Guanajuato Branch, Silao to Marfil	11
Tampico Branch, Tampico to Villa de Valles	81
Pacific Branch, between San Blas and Tepic	21
Danu Branch to Timber Tract	23
Total miles	1,360
Mexican National.	
Northern Division, Nuevo Laredo to Saltillo	234
Southern Division, Mexico to San Miguel de Allende	254
Matamoros Branch, Matamoros to San Miguel	75
Morelia Branch, Acambaro to Morelia	57
El Salto Branch Mexico to El Salto	42
Pacific Branch, Manzanillo to Armeria	29
Zacatecas Branch, Zacatecas to Guadalupe	5
Total	696
Mexican Railway.	
Vera Cruz to Mexico	264
Puebla Branch, Apizaco to Puebla	29
Jalapa Branch, Tejeria to Jalapa	61
Total miles	354
Sonora	
Nogales to Guaymas	265
Mexican International.	
Piedras Negras to Castano (Monclova)	156
Morelos.	
Mexico to Yautepec	99
Interoceanic.	
Mexico to Calpuialpam	71
Irolo to Guadalupe Hidalg;	29
Yucatan Lines.	
Progreso to Merida	20
‡ Between Progreso and Valladolid	45
‡ Between Merida and Peto	5
‡ Between Merida and Campeche	15
Puebla & San Marcos.	
Puebla to San Marcos	36
Vera Cruz & Medellin.	
Vera Cruz to Medellin	10
Sinaloa & Durango.	
‡ Between Altata and Culiacan	40
Tehuantepec.	31
Esperanza & Tehuacan.	
Esperanza to Tehuacan	31
San Martin Texmelucan.	
Puebla to San Martin	23
Sanandres.	
‡ Between Jalapa and San Andres (Puebla)	7
Puebla & Matamoros Izucar.	
‡ Between Puebla and Matamoros	57
Nautla & San Marcos.	
‡ Between Nautla and San Marcos	4
Vera Cruz, Anton Lizardo & Alvarado.	
Vera Cruz to Alvarado	34
Hidalgo.	
Irolo to Pachuca	35
Total miles in operation	3,423

‡ Road only partly finished.

Miscellaneous.

CITY ENGINEER SOMERS, of St Paul, estimates the cost of the new Robert St. foot and carriage bridge at $400,000.—*Minneapolis Tribune.*

A CRANE capable of lifting 147 tons is being erected at Hamburg. It will be the largest on the continent, the next being that already erected at Antwerp, which is capable of lifting 120 tons.

A COMPANY has been formed, with a capital of $2,000,000, to own the patents covered by the five different electric motors. Their respective merits are to be determined by a commission of scientists and engineers.

THE debt of the city of New York, as represented by stocks and bonds, on Nov, 30 was $90,117,768.90, as against $92,546,025.88 on the corresponding date last year, showing a reduction of $2,428,256.98 in 12 months.

ABSTRACT of bids opened November 19th at Office of Department of Docks, 119 Duane Street, New York, for dredging in slips and along bulk heads on North and East Rivers. Approximate quantity of material (consisting of mud and sand) to be removed 160,000 cubic yards.

Charles and Henry Dubois, 19 c. per cu. yd.; Union Dredging Co., 23 c. per cu. yd.; Morris & Cummings Dredging Co., 15¼ c. per cu. yd.; Atlantic Dredging Co., 14⅞ per cu. yd.

Contract awarded November 26th to Atlantic Dredging Company.

AUSTRALIA possesses one of the largest watercourses in the world, viz.: the Darling, which is navigable for 2,345 miles, placing it third in rank among the rivers of the world, estimated by their navigable length, and considerably above the Nile, navigable for 1,500 miles: the Danube, navigable for 1,700 miles; the Rhine, 600 and the Thames, navigable for only 188 miles.

ABSTRACTS of proposals received at the Dept. of Public Works, 31 Chambers St., New York City, and opened Nov. 26th, for building sewers in Lexington Ave. from 95th to 97th streets between Lexington and 4th Ave. Quantities of work highest, lowest, and successful bidders as follows:

1430 ft. sewers: highest $5.36, lowest $3.65, successful $3.65 per lin. ft.

80 ft. Culvert; highest $4.80, lowest $1.00, successful $1.00 per lin. ft.

3 receiving Basins; highest $176, lowest $130, successful $130 each.

1725 cubic yards rock excavation; highest $4.00, lowett $3.60, successful $3.60 per cubic yard.

5000 ft. Timber; highest 25c., lowest 20c.. successful 24c. per ft. b. m.

Bids in aggregate J. A. Devlin $12,379.50 John Slattery $13,417; John McKim & Son $15,094.80; J. Moore $13,818; V. Del. Genovese $13,437.50.

Contract awarded Nov. 29th to Jos. A. Devlin.

FOR building sewer in One Hundred and Fourth street between Tenth Ave. & Boulevard. Quantities of work; 360 lin. ft. sewer; 10 lin. ft. culvert; receiving basin 30 cu. yds. rock excavation 2000 ft. b. m. timber; M. Baird $2,529.00; A. Campbell $2,524.00; J. A. Devlin $1,859.00; J. Moore $2,220.00; J. Slattery $2,233.00.

Contract awarded to J. A. Devlin, Nov. 29; 1884.

FOR building sewers in Eighty-third street, between Boulevard and West End Avenue. Quantity of work 215 lineal ft. of sewer, 610 cu. yds. rock excavation.

F. Curry $3,243.05; A. D. Campbell $3,784.50; John McKim & Son $3,288.85; M. Casey $5,405.00; John Slattery $3,160.00; M. Baird $3,432.50; V. Del Genovese $3,516.55; J. Moore $4.110.00.

Contract awarded Nov. 29th to John Slattery.

REGULATING and grading 104th Street from Boulevard to Riverside Drive, and setting curbstons and flagging sidewalks. Quantities of work: 3,000 cu. yds. earth excavation; 4,255 cu. yds. rock excavation; 1,368 lin. ft. curbstones: 6,136 sq. ft. new flagging.

Thos. E. Crimmins, $9,889.35; G. A. Treacy, $10,295.50; A. D. Campbell, $9,584.48; J. G. Smith, $11,049.50; V. Del Genovese, $9,207.58; J. Slattery, $9,612.84; J. Slattery (bid $2) $10,060.77; B. Mahon, $9,011.10; P. Farley, $9,092.70.

Contract awarded to B. Mahon, November 29, 1884.

FOR regulating and grading New Avenue, east of and generally parallel with 9th Avenue from 145th St. to St. Nicholas Place, and setting curbstones and flagging sidewalks, building retaining wall and laying draw pipes, etc. Quantity of work as follows: 11,132 cu. yds. earth excavation, 16,255 cu. yds. rock excavation, 31,071 cu. yds. filling, 11,386 cu. yds. retaining wall, 5,211 lin. ft. curbstone, 20,800 sq. ft. new flagging 280 lin. ft. dry stone box culvert, 4 cast-iron inlet frames and gratings, 290 lin. ft. 18 in. drain pipe, 2,000 lin. ft. 6" drain pipe. Geo. E. Clark, $101,694.65; Brown and Smith, $97,638.65; B. Mahon, $67,998.70; M. Baird, $120,418.90; Allen and O'Malley, $82,940..43.

Contract not awarded. All bids rejected Nov. 29, 1884, by Commissioner Hubert O. Thompson.

REGULATING and grading West End Avenue from 72nd Street to its junction with the Boulevard; setting curbstones and flagging sidewalks therein; except between 94th and 96th Streets. Quantities of work: 41,500 cu. yds. earth excavation; 60,000 cu. yds. rock excavation; 10,000 cu. yds. filling; 16,125 lin. ft. curbstones; 60,764 sq. ft. new flagging; 280 lin. ft. dry stone culvert.

L. W. Johnson, $114,063.08; V. Del Genovese, $118,688.05; Jas Slattery, $110,629.05; Thos. E. Crimmins, $126,626.55; Maurice Daly, $108,556.83; J. McKim & Son, $128,866.34; Brown & Smith, $102,015.30; P. Farley, $120,510.30; J. Slattery, $129,575.30; M. Baird, $126,949.05; Thos. O'Malley, $98,782.38.

Contract awarded November 26th to Thos. O'Malley.

REGULATING and grading 94th Street from the Boulevard to east line of Riverside Drive, and setting curbstones and flagging sidewalks therein. Quantities of work: 13,473 cu. yds. earth excavation; 25,786 cu. yds. rock excavation; 1,950 lin. ft. new curbstones; 5,670 sq. ft. new flagging.

Brown & Son, $39,288.24; J. Slattery, $48,269.00; V. Del Genovese, $39,877.77; Thos. E. Crimmins, $42.917.50; J. G. Smith, $42,715.40; John Brady, $41,348.05; B. Mahon, $45,643.40; M. Baird, $46,161.55; D. O'Connell, $57,468.21; T. O'Malley, $83,311.60.

Contract awarded November 29th to Thos. O'Malley.

FOR regulating and grading Fort Washington Ridge Road, from junction with Eleventh Avenue at 159th street to junction with Kingsbridge Road between 192nd and 194th street.

Quantities of work: 68,163 cu. yds.: earthwork excavation, 94,274 cu. yds. Rock excavation 523 lin. ft. Drystone Box culvert A. 374 lin. ft. Drystone box culvert B; 14 cast iron inlet frames and gratings. 688 elm trees to be planted on the roadside.

Maurice Daly, $164,621.29; Brown and Smith, $160,654.16; Allen & O'Malley, $130.161,70; Thos. E. Crimmins, $177,650.31; M. Baird, $192,291.60; B. Mahon, $163,240.00.

Contract awarded to Allen & O'Malley, Nov. 29, 1884.

THE annual stockholders' meeting of the Hudson Valley Tunnel Company was held on Tuesday at No. 2 Nassau Street, and the following gentlemen were elected Trustees: O. A. Gager, William Force, C. G. Lincoln, H. W. Perkins, J. B. Houston, J. L. Martin, and A. B. Gibbs. This company was formed for the purpose of constructing a tunnel under the Hudson River. Owing to the general depression in business, it is said, no work has been done during the past year, but the Trustees hope to begin work next Spring.

THE Board of Public Improvements, of St. Louis at a recent meeting, recommended an ordinance appropriating $20,000 for the construction of the masonry of the Grand Avenue bridge. The board also fixed upon December 16 as the time to receive bids for the annual contract to repair and reconstruct sidewalks in the district between the north line of Franklin avenue and the south line of Elm street, and Twelfth street and the river. The material to be used is North River blue stone.

THE COST OF IRON BRIDGES.—A great reduction in the cost of iron bridges and their construction has taken place within late years. When the South Side (or Kernville) Bridge was built, some years ago, its actual cost was over $18,000. The Lincoln Bridge, a much better structure just completed, cost but $11,000. The bridge over the Conemaugh at Blairsville, more than twice as long as the South Side Bridge, fully as wide, with four times as much masonry, in which the best of dressed stone have been used, will cost, when completed, but little over $14,000. Not only is iron-bridge building much cheaper than formerly, but the structures are superior in many respects.—*Johnstown Tribune.*

THE city authorities of Toronto, Canada, are considering a project of improving the River Don by cutting a channel 120 feet wide. The cost of excavating the new channel, filling up the old bed of the stream, and piling on the sides of the channel would be approximately as follows:—For that portion from Gerrard street and King street, 162,000 cubic yards, $40,500; and piling the face of the cutting, $36,400—$76,900; for that portion from King street to the railway bridge, 118.220 cubic yards. $30,000, and piling the face of the cutting, $26.600—$56,600; for dredging and straightening the channel from the railway bridge to Gooderham and Wort's dock, say $10,000, a total so far of $143.500. Several bridges will have to be replaced by draw spans. The cost of these would be approximately:—For King street and Eastern Avenue bridges, $50,000, and Trunk railway bridge, $35.000—$85,000 in all. This, added to the $143,500, makes a total of $228,500 for carrying the work to Gerrard street.

AN IMPORTANT IMPROVEMENT.

A contemporary of Philadelphia says, the managers of the Academy of Music there, are having manufactured for them an ASBESTOS drop curtain which is designed as a safe preventative against fire originating on the stage, or in the flies, from communicating to the Auditorium. Asbestos is well known incombustible material, and the new curtain is composed of about two-thirds of it, and one-third cotton, it is about as thick as a Wilton carpet. If a fire breaks out on the stage, the falling of this curtain will place a perfect barrier between the stage and the audience, as the sides of the stage will also be well protected with Asbestos board lined with wire cloth. The Chalmers-Spence Co., of New York are the manufacturers of the curtain, and hold a contract for furnishing it complete.

THE governor of Dakota has published the fact of the completion of the State Capital at Bismarck by a formal proclamation.

THE Central Wisconsin bridge over the St. Croix being finished, the track is now being pushed on to St. Paul.

FORT WORTH, TEX., November 22.—The City Council met to-day to take action in regard to the contract for finishing the sewer system. The lowest bidder was M. A O'Neal, whose bill was about $10,000. Some trouble was had about proper bondsmen, and all bids were declared off and the council will advertise for new bids.

A BILL for damming the Mississippi at Brainerd, Minn., was on its second reading in the House of Representatives when Congress adjourned, and will be pushed vigorously as soon as possible after it reassembles. It is proposed to make a twenty-foot dam with a sluice and a lock. The object is to make a storage pond capable of holding 100,000,000 feet of logs, so that manufacturers will not be obliged to saw faster than the market will warrant.

THE following are the bids opened (October 31, 1884) by Colonel Elliott for excavation in Harbor of Refuge, at Wood's Holl, Mass., and Wareham Harbor, Mass. Prices are per cubic yard:

HARBOR OF REFUGE, AT WOOD'S HOLL, MASS.

J. H. Fenner, Jersey City, N. J., 75c.
A. B. Martin, Boston, Mass., 75c.
Atlantic Dredging Company, Brooklyn, N. Y., 94c.
George E. Runyon, Boston, Mass., 971-3c.
Thomas Symonds, Leominster, Mass., $1.20 (or 70c. if contract for Wareham Harbor is awarded him.)
Contract awarded to J. H. Fenner.

WAREHAM HARBOR, MASS.

Atlantic Dredging Company, Brooklyn, N. Y., 16 9-10c.
Richard M. Payne, Albany, N. Y., 16 9-10c.
Elijah Brainard, New York, 17c.
George E. Runyan, Boston, Mass., 18c.
J. H. Fenner, Jersey City, N. J., 20c.
A. B. Martin, Boston, Mass., 23c.
Thomas Symonds, Leominster, Mass., 32c. (or 23c. if contract for Wood's Holl Harbor of Refuge is awarded to him.)
Contract awarded to the Atlantic Dredging Company.

The above awards were made in accordance with agreements between the tie bidders in each case.

THE following is an abstract of the bids for dredging in Romerly Marsh, Ga., opened by Colonel Gillmore, November 17.

P. Sanford Ross, Jersey City, N. J., 21½c. per cubic yard.
James Atkins, Savannah, Ga., 22½c. per cubic
Contract awarded to P. Sanford Ross.

THE bridge which the Louisville & Nashville Railroad Company is constructing across the Ohio at Henderson, Kentucky, is approaching completion. The bridge proper will be 3,686 ft. long, with a trestle approach on the Indiana side three miles long, which, together with the Kentucky approach, will make the length of the whole structure over 4 miles. The nature of the foundation necessitates the use of caissons for the commencements of the piers, the excavations being made by men working inside of the caissons in compressed air, as was the case with the great bridges at St. Louis and Brooklyn. The work was taken in hand by the railroad company on April 15th of this year, owing to the slow previous progress made by the contractors. But four of the foundations had then been secured, and three caissons rested on the river bed out of position, 3 ft. out of level and 10 ft. below the surface of the water. Great expense and delay were occasioned in recovering these sunken caissons. Seven foundations are now secured, and work is being done on all of the fifteen foundations. Pier No. 2 has been finished, piers 3 and 4 were completed in September, and piers 5 and 6, the large piers of the channel span, were expected to be completed by October 1. The timber trestles for the first span of ironwork are up, and two of the bridge spans were erected last month. Some 920 men were employed during July, about 300 of these were at work in compressed air. The foundations for nine river piers are carried by pneumatic process to a depth of 30 ft. below the low water. In two instances 8 ft. of this distance is through solid rock. The caissons are all bedded in the rock of the river bed. The rockwork has made the process of sinking slower than usual in pneumatic work. About 100 yards of stone are delivered daily, and the masonry is laid as fast as secured. More than 1,500,000 ft. of white oak timber and 450 tons of iron have been used in the nine caissons of the river piers. More work has been done in stone this season than had been accomplished by the contractors in two years' work, and five of the piers are now above the highest flood stages of the Ohio.